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ABSTRACT

Papers which explore the aspects of current work in instructional technology and promote research and development in the field are collected in this bulletin. An introductory paper provides some general perceptives on the current state of instructional technology in relation to the contemporary educational scene and the various problems and challenges for instructional media. Eight papers enter into scme of the various issues and areas involved in research on media: interaction, cognition, aptitude, expression, perception, and learning theories. The final papers in the volume offer a summary and overview discussion of problems, as well as pose possibilities for future research. (Author/JY)

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BULLETIN OF THE SCHOOL OF EDUCATION
INDIANA UNIVERSITY

COMMENTARIES ON RESEARCH IN INSTRUCTIONAL MEDIA

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AN EXAMINATION OF CONCEPTUAL SCHEMES

gavriel salomon richard e. snow
guest editors

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INTRODUCTION

Papers presented here (from the first of a series of conferences sponsored by the Division of Instructional Systems Technology, School of Education, Indiana University) aim at exploring the many areas and aspects of current work in instructional technology, and promoting research and development in this field. This first conference addressed research on instructional media in particular but served also to introduce general problems and issues that will undoubtedly be seen again in future conference reports.

The term "instructional media" has been used loosely for decades to refer to the collection of audio-visual devices, methods, and materials presumably of use in educational communication. Programmed, and now computer-assisted, instruction has at times been included in this broad classification, at times not. One purpose of this conference was to elaborate a more detailed and well specified conception of "instructional media," to reach some recognition of the underlying commonalities and uniqueness of different instructional methods. A consensus on some explicit definition of media was not expected and was not sought. Rather, our hope was and is that the general field can be charted and that the major classes of variables and phenomena can be identified.

With such a framework in hand, a second purpose of the conference was to survey existing approaches to research in the field, identifying the critical features that will need to be embodied in research programs aimed at understanding and improving instructional media. If such features can be defined and disseminated, future research efforts might be guided increasingly by a common set of principles and thus might contribute to an integrated body of knowledge. The need for such integration has long been perhaps the most overarching need in the instructional media field. It is hoped that this conference, and those to come in the future, will stimulate significant progress toward this end.

The present report is organized in three sections. First, the paper by Allen provides some general perspectives on the present "state of the art" in relation to the contemporary educational scene and the various problems and challenges for instructional media apparent therein. Second, a series of eight papers, by Mielke, Salomon, Snow, Seibert, Eisner, Fleming, McDonald, and Conway explore the areas and issues involved in research on media. Finally, DeCecco, Salomon, and Snow offer some summary and overview discussion of problems as well as pose possibilities for future research.

The editors wish here to thank the participants for their contributions and their cooperation in this first conference, and the administration of the Division of Instructional Systems Technology, Indiana University, for making this series possible.

--G.S. and R.E.S.
Guest editors

CATEGORIES OF INSTRUCTIONAL MEDIA RESEARCH

william h. allen

THERE ARE MANY WAYS to categorize the research with instructional media, all of which may be valid for particular purposes and several of which may be useful as maps of the territory encompassed by such media.* The classification scheme presented here represents one tentative attempt to block out the structural features of media research in the expectation that such a model may lead to a more systematic knowledge of the field and even suggest variables for future study. As such, it is more descriptive than prescriptive, and is intended as an introduction to the types of problems warranting investigation.

Traditionally, research on instructional media has

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*For the purpose of this discussion, "media" is a generic term referring to a class of instructional resources and representing all aspects of the mediation of instruction through the agency of reproducible events. It includes the materials themselves, the instruments used to deliver the materials to learners, and the techniques or methods employed.

focused on the different classes of media. Thus there has been a plethora of research on film, television, programmed instruction, audio presentation, computer-assisted instruction as such to the exclusion of research on factors that are more directly related to the learning process. It is only within recent years that systematic attention has been given to research on these variables, perhaps impelled by the application of rigorous analysis of instructional objectives, the nature of the content, and the techniques of materials design advocated by the behavioral psychologists, particularly as it applied to the development of programmed instructional materials.

This conceptualization of the more appropriate and relevant research has switched attention away from the broad class of evaluative research that is so unproductive in terms of direct, scientific contributions or generalization to a consideration of those individual and situational factors that may interact with media to make them more or less effective instructional instruments. It is to the description of these factors that this paper is directed.

The Classification System

Factors relating to the stimulus

The first area of instructional media research deals with the instructional material itself--the nature of the stimulus material, its form, organization, and design. It would appear that there are at least four categories characterizing the research into this area:

1. Characteristics of media types. Although the broad and undifferentiated research in which one type of media (motion pictures, programmed instruction, television) is compared with another or with some other kind of material presentation may be subject to criticism, it nevertheless exists as a legitimate category for research. The criticism of such research, as explicated by Lumsdaine (18:594-601), concerns the comparisons of a single instrument or class of

William H. Allen, professor of education and director of research in the Department of Cinema at the University of Southern California, acquired his Ed.D. degree from the University of California, Los Angeles. He formerly was an associate social scientist and advisor on communications in the RAND Corporation and System Development Corporation in Santa Monica. In addition to his teaching and industrial careers, Dr. Allen has been active in professional organizations. From 1953-69 he was editor of *A V Communication Review*, the research journal of the Department of Audio-visual Instruction (DAVI) of the National Education Association. He was president of DAVI in 1963-64.

instruments of certain type (e.g., motion picture) with those of another type (e.g., conventional instruction) wherein there is lack of specificity between the alternative modes of instructional presentation. However, there would appear to be justification for comparisons of different media wherein all factors other than the unique specific media characteristics are controlled. An example of such a study was that reported by Gropper (14:37-69) in which programmed "visual" lessons were compared with programmed "verbal" lessons in the teaching of scientific concepts and under different conditions of student response, mode of response, and mode of testing.

2. Characteristics of stimulus presentation forms. Closely associated with the above category and directed toward the same objective is research on different stimulus presentation forms. The term "stimulus presentation form" is used in the sense advanced by Tosti and Ball (24:5-25), that is, as encoding dimensions of media that comprise a more general class of characteristics than do the specific media types. Tosti and Ball listed four such forms: environmental structure (the real object), pictorial, symbolic, and verbal. Other kinds of presentation forms are also possible: for example, realistic vs. abstract, motion vs. still pictures, and expository vs. programmed text. The crucial point here is that the stimulus materials have different

characteristics which can be identified and their instructional values determined for particular instructional outcomes. Whether the variables shown above are important or even relevant will be determined only by future research. There is little question, however, as to the educational significance of further investigation of the form of presentation. Little research has been conducted on such problems although Conway's work (9:371-385, 10:403-414) and the study by Allen and Weintraub (4) are suggestive of some research approaches that might be undertaken.

3. Media production variables. Research on specific production variables has been conducted for many years, beginning with the extensive Instructional Film Research Program at Pennsylvania State University following World War II (7, 8) the U.S. Air Force research program directed by A. A. Lumsdaine from 1950 to 1957 (17), and the more recent large body of research on programmed instructional variables. This category of research encompasses a wide range of production variables that would be built into the materials themselves at the time they are produced. Examples of such factors are: color vs. black and white film, visual and auditory embellishments, camera angle, animated vs. live photography, variations in the audio narration, attention-gaining devices, characteristics of captions, step size, linear vs. branching programming, and countless others. Hoban and Van Ormer (15) reviewed research on production variables, and two recent reviews by May (19, 20) treated these factors in greater detail.

4. Internal organization of media. Related to research on the production variables and difficult to separate from it are several broader and more prevailing factors. These variables are concerned with the internal organization of the media itself and include such factors as the sequencing of instruction (6), the compression of information (25), repetitive presentation (2:123-130), structure of the message, and the rate of presentation. Little research is extant concerning these elements, but the need for future investigations is clearly evident.

Factors relating to student response

Even prior to the present surge of research on student response factors in programmed instruction, considerable research attention had been given to this variable. Allen (1:42-43) and Lumsdaine (18:583-682) had reviewed the literature in depth, and Lumsdaine had edited the symposium volume, *Student Response in Programmed Instruction* (1961), which contained a number of experimental studies of cue and response factors in group and individual learning from instructional media. Thus, considerable evidence has accumulated to indicate that student response or participation of some kind accompanying exposure to instructional media is one of the most prevailing contributors to increased learning. However, the precise conditions under which these responses may be optimally evoked are less clear, and continued future research is indicated. Lumsdaine's (18) review of the research literature presents a number of variables that deserve study: amount of active response, time as a variable, form of overt response, overt vs. covert responding, feedback and knowledge of results, reinforcement, guidance and cuing, and prompting vs. confirmation. These factors and numerous others not stated suggest the rich research possibilities with the student response variable.

Factors related to content attributes

There are several ways to investigate those characteristics of the learning experience that we call content attributes. By "content attributes" we mean those qualities of the main substance or meaning of the corpus of the instruction. Thus, the content attributes include far more than the subject matter content of the instruction alone, but extend to those different ways of looking at the essence or purport of the teaching. Different categories of content attributes will be presented, all susceptible to research and as yet inadequately investigated.

Subject matter content. The relationship of the

different media to instruction in various subject matter content areas (e.g., science, social studies, art, mathematics) has not been determined. Early studies have suggested that subject matter content is not a variable when determining media effectiveness, media use being as appropriate in one school subject as another. However, a recent study (4) indicated that an interaction might exist between the subject matter content and the particular learning objective being served regardless of the instructional media used. Some attention to the subject matter being taught might be given in future media research.

Broad instructional objectives. Increasing research attention is being accorded to the interactions of media with those broad educational objectives described by Bloom and his associates (5, 16)--cognitive, affective, or perceptual-motor. In recent considerations of this question (13, 21, 11) the need for a more precise fit between the type of media used and the objectives being served was implied. There is some evidence that media may interact differentially with the various instructional objectives, but the precise directions such interactions take is not clear.

Learning hierarchies. The hierarchical learning tasks described by Gagnē (3)--signal learning, S-R learning, chaining, verbal association, multiple discrimination, concept learning, principle learning, and problem solving--comprise another way the content attributes may be categorized. The conditions of learning Gagné sets forth assume a hierarchical order of knowledge acquisition, each higher order of learning depending upon mastery of all other orders subordinate to it. It would appear that a fruitful line of research would be the determination of the relationships and the appropriateness of the different media or media combinations to the learning of the different levels of the hierarchy.

Learning tasks. Closely related to the learning

hierarchy category, and possibly subordinate to it, is the classification of the content into different types of learning tasks. The grouping of learning tasks into an order that includes the identifying, comparing, classifying (conceptualizing), generalizing, and applying of content presented for learning probably follows a hierarchical order. On the other hand, such tasks as learning facts, learning procedures, learning to solve problems, etc. probably do not fall into a hierarchical order. The critical point to note in the classification scheme for media research that is being explicated here is that different learning tasks may be learned differentially under different presentational conditions. The determination of the appropriateness of different forms of media for the presentation of different tasks may be an important area for future research. Little research attention has thus far been given to this problem, although Allen and Weintraub (4) have gathered some preliminary evidence.

Instructional functions or technical skills. Yet another way of considering the content atributes is in accordance with the particular functions or skills they are designed to establish. Gagné (4) presented the following eight instructional functions and attempted to rate the various media types according to their value in accomplishing each function: presenting the stimulus, directing attention, providing a model, furnishing external prompts, guiding thinking, inducing transfer, assessing attainments, and providing feedback. Gage (12) presented a list of technical skills, some of which overlapped with Gagné's functions: establishing set, establishing appropriate frames of reference, achieving closure, using questions, recognizing and obtaining attending behavior, control of participation, providing feedback, employing rewards and punishments, and setting a model. It is evident that such categorizations as these relate very directly to specific teaching activities, and it is reasonable to expect that the teaching procedures used--including the use of media of different kinds--could have a variable effect upon the acquisition of each of the skills.

Content inherency. A final category of content attributes might be called "content inherency," in which an assumption is made that the content itself possesses certain inherent dominant traits that could interact with the mode of presentation used. Allen, Filep, and Cooney (3) found some confirmation of this assumption in a study that characterized the content as consisting predominantly of verbal concepts for which there were no direct concrete referents and of content having referents of a concrete nature. They found that no media-inherency interactions existed for the "non-concrete" content, but that the "concrete" content was learned more effectively when presented by means of pictorial material. Other types of content inherency might be included for study--for example, abstract vs. concrete or action vs. non-action.

The six categories of content types discussed above were not presented as exclusive categories, but rather as suggestions of the kinds of ways the researcher might look at the instructional content. Some of these may be completely inappropriate for investigation, and additional categories may be added. The important thing to keep in mind is that there is an extensive group of intervening variables, possibly interrelated and overlapping, that have received virtually no research attention and which may be highly important when selecting the mode of instructional presentation.

Factors relating to learner attributes

The significance of the learner's characteristics as a variable in educational research has been recognized for a long time, and many facets of such learner attributes have been studied under a variety of instructional conditions. As discussed by Snow and Salomon (23:341-357), however, this factor has been largely neglected in research on instructional media; and they have marshalled considerable evidence to support the need for inclusion of aptitude variables in future research. Such learner aptitude variables as age, sex, mental ability, personality factors, learning styles,

and cultural factors, would seem to be appropriate factors for inclusion.

Factors relating to psycho-physical processes

The inclusion of this category of research within the classification scheme is prompted by the belief that there are processes operating in learning and instruction that may be relatively invariable through the population as a whole and which sould be considered as the basic underlay for any kind of instructional event. The exact nature of these factors can probably not be precisely defined at this time; but, they might include such overriding considerations as perceptual, physiological, motivational, and cognitive factors. For example, any research on mediated instruction should probably take into consideration the principles of the research design. It is not really clear to me whether or not this factor is manipulable in the experimental sense, but I have a hunch that the particular operations of the perceptual process interact differentially with various media types or forms. The question is left open here and is included merely to suggest that this area may be susceptible to fruitful research.

Factors relating to instructional use

Another category of research effort is that in which the variables related to the actual instructional application of the media in the classroom are investigated. Thus far in the explication of the categories of instructional media research we have been concerned with those factors relating to characteristics of the instructional material, the nature of the content being taught, and the attributes of the students who are engaged in learning. The focus in this section is on the activities of the teacher, who brings these elements together in the instructional situation.

Teaching techniques. This category of research involves the study of specific procedures the teacher uses in

manipulating the instructional media. For example, research has been conducted on the use of introductions to films, study guides, student participation techniques, direction of attention, repetitive use of materials, and discussion follow-up (2:123-130). Although considerable research evidence has already accrued, these, and countless other techniques, may be investigated in order to discover their effects upon the learning of the material.

Instructional strategies. At a higher level of teacher use are those instructional strategies that might be employed to enhance student learning. These could include such strategies as the use of inductive-deductive methods, discovery vs. directed methods of teaching, rule-example relationships, feedback and knowledge of results, the establishment of learning sets, the use of anxiety-producing and fear-arrousing communications, etc. Very little research attention has thus far been given to these factors, and the need for investigation appears to be great.

Teacher characteristics. We know virtually nothing about the relationships of certain teacher characteristics as they affect learning in the classroom, much less learning from different media types.

Factors external to the direct instructional situation

Finally, there is that extensive group of factors that will doubtless influence the overall impact of media, but which are outside the control of the media designer, the materials producer, the student, or the teacher. Such factors are the administrative procedures used in the organization of the school itself and/or the media program within the school, cost-effectiveness benefit considerations, the nature of innovative practices, applications of media to teacher education, psychometric applications, course development procedures, the design and development of equipment, etc. With some notable exceptions these areas have yet attracted hard systematic research effort.

Conclusion

In the attempt to categorize instructional media research into a meaningful structure it has been necessary to break it into neat circumscribed categories. In actual practice, however, this just does not occur. The significant feature of research today is not the investigation of carefully isolated hygenic variables, but rather the investigation of several interacting variables (22, 23:341-357). As we discover these interactions and build them into a media design model, developing theories of media use, we may approach a true science of instruction.

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. . . We can sharply improve the teacher by improving the instructional material he uses. Thus the student will have access both to the live teacher in the classroom and to the teacher mediated through print, photograph, film, television, videotape, magnetic tape, radio, filmstrip, EVR (electronic video recording), or other devices.

---Edgar Dale, Editor
The News Letter
March, 1970

It is simpler and more comfortable to make moral judgments on each of these actions than it is to understand their meaning. Vandalism and violence, strikes, fiscal neglect, and confrontation are symptomatic of profound and complex discontent. We must hear the complaint for what it is--a plea for reform and action.

Once again schools must become mind-expanding experiences--for students and teachers. The nineteenth-century classroom does not meet the needs of twentieth-century society. The electronic revolution that has so seized the American community must be let into the classroom and made an integral part of the educational process. Likewise, teachers, administrators, and school boards must come to accept the importance of audiovisual and electronic aids. We are shamefully negligent in any effective use of television in the educational system. Cybernetics and television have become mainstays in the American Way of Life. They must serve equally in education.

---*Hubert H. Humphrey,*
guest editorialist in
The School Administrator,
May, 1970

MEDIA-MESSAGE INTERACTIONS IN TV

keith w. mielke

THE WORD "interaction" refers here to special types of relationships among variables. Here is one example of interaction: In terms of how comfortable you feel, there is an interaction between what you wear and where you are. The hypothetical data below illustrate this:

Comfort Indices for Two Types of Clothing in Two Locations

Outfit	Percent of Time Outfits are Comfortable in Alaska	in Hawaii
Swim Suit	10%	90%
Fur Coat	90%	10%

In predicting how comfortable you would be, you can't say that either Alaska or Hawaii is best across the board. It depends on another factor: what you wear. Also, you can't say that, across the board, the swim suit is more comfortable

than the fur coat or vice versa; it depends on where you are. The swim suit is satisfactory in one setting, but less so in the other.

The analogous topic being explored here is the possible interactive relationship between medium and message in televised instruction. Are some messages likely to be more effective over one medium than another? Are some media more effective when carrying one type of message than another? Can you predict "across the board" effectiveness on the basis of medium or message alone, or do you need to take both medium and message factors into account before making the prediction? What types of messages are best suited to the television medium?

These are not comfortable questions to grapple with. The more dedicated one is to scientific values of precision, rigor, and theoretic relevance, the more uncomfortable he feels asking such global questions as "What can television do best?" Nor can we expect precise, clean-cut answers to such general questions. These questions are raised, then, not out of initial preference, but from frustration in trying to reconcile the empirical view of instructional television (ITV) collected to date with persuasive but more intuitive insights into the medium of television.

The "hard" research data comprising the empirical view of ITV has been summarized periodically and extensively (5). This literature contrasts with the "softer" insights into the medium of television that have received less attention by the ITV community. Varying degrees of sensitivity to a potential medium-message interaction in television can be found in these more speculative remarks. What follows is not intended to be a formal literature review. Instead, the series of brief quotations should function as montage would function in film: a rapid succession of "images" designed to elicit association of ideas. The quotations are arranged so as to form a crude continuum of viewpoints, beginning

Keith W. Mielke is newly named chairman of the Department of Radio and Television at Indiana University where he has been a member of the faculty since 1964. During that time he also has been directing media research projects as well as guiding the interdisciplinary Ph.D. program in Mass Communications. In addition, for the past two years he has been research editor for *Educational Broadcasting Review*. Dr. Mielke, who earned his Ph.D. from Michigan State University, began his teaching career as a music instructor in the Fort Morgan, Colorado Public Schools in 1956. During his graduate work he had opportunities to assist Dr. Lawrence Myers, Jr. at Syracuse University, and Dr. Hideya Kumata and Dr. David K. Berlo at Michigan State.

with *minimal* emphasis on the unique contributions of the television medium.

> At present, however, there is little evidence that there will be evolved any technique of instruction which is *totally* distinctive of instructional television. By and large, television provides the opportunity to put old wine in new bottles. (8:30)

> Evans (1964) prepared an hour-long filmed interview with Carl Jung. Some of his students in psychology were shown the film. Others read only the printed transcription of the interview. Test results showed that both groups learned from the presentation, but there was no significant difference between the two groups. (6:91)

> When it comes to format, interest and learning appear to depend on considerably different qualities. Presentation of similar material to proper control groups has almost invariably resulted in students rating programs with dramatic or documentary formats as more enjoyable and more interesting than those presented in straight talk or interview programs, even using the same visuals. Yet test results increasingly indicate that more is usually *learned* from the simpler formats. This is fortunate in view of usual educational budgets. With regard to popular commercial programs, it is likely that young people learn less from dramatized programs of violence and antisocial behavior than they would learn from talk programs teaching the same techniques and behavior.
>
> The techniques of Mike Hammer, James Bond, gangsters, and others, in other words, would probably be taught somewhat effectively by simple talks

and demonstration programs than they are in their present dramatized form. (23:61)

An interesting experiment was conducted at New York University several years ago, with two courses, both on television, one with all kinds of video gimmicry, with graphs that melted and reformed themselves, and all sorts of wonderful things, and the other course with simply a lecturer talking to the students. The students all found the first one much more interesting, but two-thirds of them failed. I don't want to go on with the implication of this suggestion except to suggest that technical people involved in TV may want to make a little more video interest than perhaps is necessary, to make a Shakespeare 'show'; as they used to say, instead of a Shakespeare 'lecture.' (14:92)*

The questions must be asked, Is there any instructional value in having a professor deliver a lecture with no student participation which would warrant the use of televised lectures instead of using, as a distribution form, the same lecture material printed in mimeograph form? It is a different type of input, but is it better? Videotape has been used merely to replicate what is presented in a lecture-class situation. In terms of economics, the benefits of print are obvious. (4:8)

As is true in the case of the conventional media, the newer techniques do not adequately serve some purposes. Their successful use requires the recognition both of their strengths and their limitations. They are not useful, for instance, in some forms of discussion, supervision of activities, consideration of unanticipated questions, or individual consultation. (7:43)

Television can be used--and in some places is being used--to do the traditional job of education, and to do it well. However, those who have had experience with the medium know that, if wisely and imaginatively used, it also can bring to students educational experiences far beyond what is possible in the conventional classroom. Students in today's classrooms can be eyewitnesses to history in the making. They can have a closeup view of physical and chemical processes that cannot be duplicated in any but the most expensive laboratories--indeed, some that cannot be duplicated in any laboratory. They can see and hear the outstanding scholars of our age. They can have access to the great museums of art, history, and nature. A whole treasure-trove of new and stimulating experiences that were beyond the reach of yesterday's students can be brought into the classroom for today's students. (11:68)

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*Hans Moeller, "Production: National Film Board Resources," in Lewis Miller, ed., *Educational Television: Conference in Newfoundland and Labrador, 1966.* © 1967. Reprinted with the permission of Information Canada.

> Most producers, directors, graphists and television teachers had been trained to manipulate television as a mass communication device primarily suited to passing along information. They often lacked a basic understanding of how an individual perceives and learns. Moreover they had little knowledge of the newer concepts of organizing and sequencing instructional presentations for effective individual learning. They tended to treat the medium as a mirroring non-interactive surrogate of the classroom teacher in his old familiar role as a talking dispenser of information. (25:15)

> Researchers have noted that the different media are capable of producing different kinds of effects. It is often suggested that print media are often more effective in conveying information, while radio and television are more often persuasive due to their abilities to simulate social contact. (17:68)

> Some of our difficulties here lie in the fact that we take television for granted, attribute great power and influence to it, yet lack an adequate theory of media. Theories of signs and iconicity are not of great help, if for no other reason than they are more or less speculative, and are heavily philosophical rather than psychological. In coping with the realities of media in education, such theories have roughly the same utility as Marie Antoinette's cake. (13:33)*

> Communications channels impose conditions on the audience--by their physical demands and by the social situations they encourage or preclude. Theater films are presented to large numbers of people sitting together quietly in the dark. Novels are usually read alone, with little distraction, and at a time, place, and pace selected by the reader. Television is more often watched after the evening meal, in a particular room of the home, and by several family members at once. The media also vary in the size of their audiences, simultaneous and accumulative. Over time, such concomitants give rise to important and persistent generalized associations. As a result, significant aspects of attitudes and feelings toward the various media relate not only to *what* is seen or heard or read, but to theater-*going*, or novel-*reading*, or tele*viewing*--in and of itself. (24:51-52)**

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*Charles F. Hoban, "The Dilemma of Adult ITV College Courses Courses," *Educational Broadcasting Review*, vol. 42, no. 3, © 1968. Reprinted by permission.

**Gary A. Steiner, *The People Look at Television*, © 1963 by Alfred A. Knopf, Inc. Reprinted by permission.

> . . . No medium of mass communication exists in a vacuum. It is part of tremendously complex and changing social and cultural systems within which it exists and operates. Its fate will be dependent not only upon the characteristics of the medium itself, but upon the existence within those same systems of a set of salient norms and values that shape and influence it. Its destiny will also be partly influenced by the presence of other media with which it must come to terms. It is in these ways that a society has a profound influence upon its media. (9:75)*

> There has been a great deal of discussion in recent years about the devices that can be employed to aid in the teaching process. These devices are of many kinds. Some of them are designed to present material to the student of a kind that would be available to him in his ordinary school experience. Films, TV, microphotographic film, film strips, sound recordings, and the like are among the devices ordinarily employed in such work. Books also serve in this role. These are the tools by which the student is given vicarious though 'direct' experience of events. It does not serve much to dismiss such materials as 'merely for enrichment,' since it is obvious that such enrichment is one of the principal objectives of education. Let us call these *devices for vicarious experience*. (2:81)**

> In terms of the message, the more dimensions or channels involved, the greater the realism. But realism also involves fidelity. For instance, continuous motion is more 'real' than a still picture sequence. Thus, other things equal, television or motion picture with full sound has greater realism than TV or film with sound dubbed in, the latter has greater realism than silent film, silent film has greater realism than still photography, etc. (1:241)

> Merely to put the present classroom on TV would be like putting movies on TV. The result would be a hybrid that is neither. The right approach is to ask, 'What can TV do that the calssroom cannot do for French, or for physics?' The answer is: 'TV can illustrate the interplay of process and the growth of forms of all kinds as nothing else can. (16:332)

> Television is not just a medium, not just a tool, a device, a gimmick, a gadget to be used for teaching. You cannot necessarily teach effectively

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*Malvin L. DeFleur, *Theories of Mass Communication*, © 1966, by David McKay Co., Inc. Reprinted by permission.

**Jerome S. Bruner, *The Process of Education*, © 1965, by Harvard University Press. Reprinted by permission.

on television by setting the camera up pointed at a teacher. You do have to have what the networks and commercial stations call 'production.' (27:61)

One disappointing aspect of the research on instructional television over the past decade is the relatively small number of studies that have dealt with production variables or variation in methods of organizing and presenting the program content. This is rather surprising since television production facilities are widely available and since it is not a difficult task to develop differing versions of televised lessons or courses for comparison under controlled conditions. (12:14)

The color and brightness, referred to in commercial television circles as slickness, should be brought in to make illustrations clear and to demonstrate through pictorial means the points the professor is trying to make. For instance, instead of the traditional television close-up of the face of an economics professor lecturing about the circumstances during the depression and the bread and soup lines, the screen should show film clips of dejected people cold and hungry waiting in lines to get a bowl of soup and a piece of bread. (3:1)

As presently organized it is difficult to believe, for instance, both the transmission channel views and the film language views. If film is a transmission channel only, then clearly it has no unique 'language'; if film does organize experience in unique ways, then it is not merely a transmission channel. (21:375)

There is some tendency to confuse the physical paraphernalia of television as a transmission medium with its stimulus properties per se. From the latter standpoint, film and television can be considered substantially identical media for many purposes (aside from such physical properties as grain, color, and screen size, and the much-talked-about factor of 'immediacy' or suspense in live television). But since many television programs are pre-filmed, or recorded for later playback on film kinescopes or video-tape, the distinction between TV and film is at best a fuzzy one--both media producing essentially moving pictures, in the generic sense, with sound accompaniment. (15:478)*

For each communication channel codifies reality differently and thus influences, to a surprising degree, the content of the message communicated. A medium is not simply an envelope that carries any

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*Arthur A. Lumsdaine and Mark A. May, "Mass Communication and Educational Media," *Annual Review of Psychology*, vol. 16, © Annual Reviews, Inc. Reprinted by permission.

> letter; it is itself a major part of that message . . . . (5:176)

Is educational television merely a convenient distribution method? To some extent I am sure it is; but I am not satisfied that it is entirely. Educational television must have a special language of its own, and let's try to find it. I'm not sure that we have. There are experiments here and there that suggest that educational television can be far more interesting than it generally appears to be. So let's try to explore this special language and let us experiment with the medium, as we have for many years with other visual educational media. (19:122)*

The results seem to substantiate the use of visual aids in promoting student achievement of learning objectives similar to those measured by the drawing test. Or, we need to reorganize our thinking on the types of critical measures we employ; that is, visualizations may increase learning that is not detected in the tests employed. (10:41)

If production techniques of the medium and the effect of visual and audio stimuli were identified in the studies at all, they were usually treated as intervening variables. Why has the medium itself received so little research attention? Why has the broadcaster accepted the role of providing only a pipeline from the source to the receiver? (22:25)

Just as Vasily Kandinsky established a new aesthetic of painting by working inductively with the basic elements of point, line, area, texture, and color, we can establish a television aesthetic by examining the factors of light, space, time and motion, and sound, and by experimenting with a variety of factor combinations, all within the framework of television communication. The examination of the various factors will help to build the television vocabulary; the combination of these factors will suggest the potentials of a television language; and the recurring trends within the various combinations might, eventually, suggest a television grammar, a system which will permit meaningful production research. (23:38)**

If you are tuned to KQED, San Francisco, one of the more adventurous educational stations, you sometimes pick up weird images. The telecasts are sketches or doodles of the electronic art of the future. Artists and technicians at KQED are exploring the potential of broadcast art. 'Electrons' says experiment director Brice Howard, 'are our medium.'

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*Sidney S. Lamb, "Credit Course Programming: The University Television Teacher," in Lewis Miller, ed., *Educational Television Conference in Newfoundland and Labrador, 1966*. © 1967. Reprinted with the permission of Information Canada.

**Herbert Zett, "The Study of Television Aesthetics," *Educational Broadcasting Rwview*, ©1968. Reprinted by permission.

> And the picture tube is the canvas. Moving images are blended many times over on video tape (like making a double-exposure snapshot, only more so), and then sound is added. The result is a flowing video montage--a little like a painting that you turn on instead of hang up. (26:61)*

Although the quoted remarks may correspond only roughly to the pure hypothetical continuum, it can be seen that the area of media-message interactions in television would fall in the middle, where contributions of both media and message are consciously sought. Consider the media-message interactions implicit in the following excerpt from a televised review of ITV. The verbal sound track begins as follows:

> When it began in the early fifties, extraordinary promises were made for instructional television. To every classroom it would bring the performing arts. Television would bring to students the events of today and the history of tomorrow. Television would reveal the otherwise invisible. It could also simplify the complex and abstract. Students would encounter creative people. Master teachers would reach more students through television. Television would capture the reality of other lands. It would reveal critical problems of our own nation. (20)**

The very phenomenon of media-message interactions now prevents a realistic portrayal of the televised information that accompanied those words. When the off-camera voice said "To every classroom it would bring the performing arts," an orchestra was seen and heard. No arrangement of words here can reconstitute the sight and sound of the orchestra. No matter how economical or efficient, print cannot handle this job. If, on some measure, there would be "no significant difference" between the televised version of the orchestra and some mimeographed, printed, verbal rendition of the orchestra, it would tend to reveal more about the nature of the measure itself than about similarities of media.

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* ©1969, *TV Guide*. Reprinted by permission.

**Printed by Permission. National Instructional Television.

Those who have sampled ITV will know that the "typical" lesson does *not* bring to the classroom the performing arts, the history of tomorrow, the otherwise invisible, or the like. The characteristic of the television medium most consciously exploited seems to be its multiplicative potential, its economy of distribution, its ability to reach many classrooms with one teacher. Early advocates of television in education frequently made their case on the characteristics of TV as a *distribution system*, as opposed to a method of *information packaging*.

Conceiving of television as an electronic pipeline or as an electronic extension of the eye relieves one of considerations of content or content-medium interactions. Clear-cut examples of this pipeline analogy would be, say, the television systems that monitor hotel lobbies and prison corridors. The pipeline itself is insensitive to what passes through it. The eye can be extended to see more of the same things it normally sees. As a distribution system, television would be evaluated primarily by engineering criteria.

Of course, when television is used in the service of education, content considerations cannot be ignored. There is necessarily some degree of concern with the content of the stimulus, some degree of concern with television as a method of information packaging. Given conscious control over what comes through the channel, there is probably some bed-rock minimum interaction between *what* is said televisually and *how* it is said televisually.

To structure this idea a bit, three arbitrary levels might be differentiated: (a) At the lowest level of message-medium interaction, a typical classroom teaching performance would be given a very "straight" TV production treatment. (b) At an intermediate level, there would be expansion of the kinds of content covered (e.g., televised field trips, outside resource persons, etc.) but still fairly "straight" production treatment. (c) At the highest level of message-

medium interaction, the raw material would be expanded far beyond the confines of the classroom as in level two, but there would also be extensive and conscious manipulation of the production variables.

Careful consideration would be given to the presentational style, the televisual "statements," the conscious structuring and control of the stimulus to achieve a desired effect. There would be awareness of what might be called the "language" of television, as well as an aesthetic or pedagogical rationale for using one treatment instead of another. This trichotomy is admittedly very imprecise, and it should be abandoned at once if a more useful structure or taxonomy can be imposed on these same concerns.

There are real world counterparts to these three levels, however, so perhaps useful distinctions can be made in spite of the imprecision. Examples abound for level one. The ITV lessons now cited as being exemplary are frequently in level two. Rarely in ITV, but apparently more frequently in film, is the audio-visual stimulus package so carefully controlled and orchestrated as to qualify for level three.

Value judgments persist throughout this paper because so little in the way of media-message interaction is demonstrable fact at this point. Production values in television are defended more on the basis of conviction than research evidence. The "hard" evidence, as some of the earlier quotations suggest, does not encourage this line of thought; in fact, "production" seems to have acquired a slightly tainted image in ITV after most of the few studies dealing in any way with production enhancements failed to demonstrate their instructional advantages.

Why might this be so? At least three factors may be working against greater research activity in television (18: 54-61). First, in certain applications of experimental methodology, production enhancements could be considered as

errors to be eliminated or controlled out. The *ceteris paribus* (other things equal) preamble, applied to a comparison of live versus televised instruction, means that television should be restricted in the research project to the content and treatment available in the classroom. A dilemma arises: the more dissimilar the comparative treatments (live and TV) become, as when unique contributions of TV might be exploited, the more uninterpretable the results. The tighter the controls, i.e., the more rigid the imposed similarity, the less freedom in either the live classroom or the televised version to exploit natural advantages. An investigator need not get caught in this trap, but if he does, his unfortunate choices are to "sloppy" or "unnatural."

Second, there is a two-sided problem with the *measures* actually used to determine effectiveness. In ITV, effectiveness has been defined overwhelmingly as learning. Learning is usually defined as test results. Tests tend to measure some form of acquisition of information that was presented originally in the verbal audio track. The audio track then becomes not only *necessary* for satisfactory test results, but, in all probability, *sufficient* instruction for satisfactory test results as well. Given such a measure, how could one expect production enhancements to make a demonstrable improvement in learning? Part "A" of this problem, then, is that the typical basis for evaluation is probably insensitive to the media-message interactions which exercise the potential of television.

Part "B" of this problem is that the *alternative* bases for evaluation are more difficult to conceptualize clearly and even more difficult to make operational. In some cases, appeal can be made to "self-evident" values, benefits that are so intuitively appreciated as to not demand empirical justification. For example, television interviews with famous persons may yield no better "learning" scores than a second-hand retelling of the major points, or a printed transcript. However, the experience of seeing the famous

person is worth something (although it would be difficult to specify exactly what). A televised course in American government at Indiana University incorporated several interviews with important national officials. Their comments typically did not fall into an easily testable format.

How, then, would you demonstrate that the interviews contributed anything of educational value? If each practice had to argue its way into the course on the basis of typical learning scores, it is doubtful that the interviews could be justified. A practice could, however, be "defined" as valuable, or *other* types of measures could be obtained to assess their contribution. For example, at end-of-course evaluations, students mentioned in free response items their *enjoyment* of the interviews. In exploratory research involving sequential still photographs of the students as they were instructed by ITV, it appears from preliminary data that the students *looked* at the screen considerably more in the interviews than in other traditional lecture lessons. Does it make any difference whether the students "enjoyed" the interviews? Does it matter that the students looked more consistently at the screen during interview lessons?

These questions may not seem as immediately relevant as the question, "Does it matter what score the students achieve in the final exam?" All three questions must be related to the educational objectives before they can be answered. These examples will serve to illustrate that there can be many significant differences between two instructional settings even though there may be no significant difference in typical measures of learning. The effects of using the medium of television would probably influence these "noninformation acquisition" measures more than they influence the typical test scores.

Third, the aesthetic and complex nature of many production decisions does not yield easily to the orderly classification of factors desired by the empirical researcher. Research

which asks simplistic questions such as the relative effectiveness of medium shots versus close-ups may be tightly controlled but may be quite unrelated to the dynamic, multidimensional, decision-making environment of the TV director.

Major contributions can be made by the research community in the development of new measures of communication effects. A variety of forms of these measures (paper-pencil tests, physiological measures, nonreactive measures, etc.) along with an increased sensitivity to what to look for, will collectively tighten the net on the elusive effects that are now untouched by most formal criteria in ITV. The cruder and more restricted the measures, the less able we are to assess the real effects of media-message interactions in ITV, and the longer we must rely on intuitive insights.

The interactions between medium and message in television may never emerge with the high definition afforded by the opening hypothetical example (interaction between what you wear and where you are). The concepts in the television setting are not as straightforward. The proposition that seems to be the clearest of the lot is that the medium of television alone has no communication effects. This is demonstrable in two ways: by removing the message from the screen entirely (blank screen), or by carefully contriving an artificial situation in which the message is actually held constant across two different media. (18:54-61)

Messages do have effects. As a passive electronic pipeline, TV may possibly carry a wide variety of messages with only minimal influence on the effects of those messages. More typically, however, the television medium will interact with the message to modify it or produce a new message. In considering television as a method of information processing and packaging, we are more likely to consciously seek and accurately assess the more potent interactions that are different from the typical classroom stimulus patterns are made possible with television. These involve television production

variables or what is sometimes called the language of television. Although the effects of what a production man would call "good television" are beyond our measurement capacity at this time, it would be extremely shortsighted to downgrade concern with production because of that.

Several different factors can be associated with favorable conditions for high-potency medium-message interactions in ITV. The profile shown below is neither complete nor intended as a precise description. Instead, it might serve as a tentative conceptual map for discovering the presence, extent, and impact of medium-message interactions in ITV.

verbal							X	nonverbal
concrete	X							abstract
high control over stimulus	X							low control over stimulus
verbal analysis of experience							X	simulation of direct experience
high amount of incidental learning, not covered on formal exam	X							minimal amount of incidental learning, not covered on formal exam
cognitive							X	affective
primarily digital information				X				primarily iconic information
low visual stimulation							X	high visual stimulation
difficult-impossible to reproduce or simulate in live classroom setting	X							possible to have similar stimulus package in the live classroom

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. . . Violent revolutions throughout history have occurred when a country's institutions were too rigid and unbending to accommodate change.

Even the most conservative will agree that some changes are needed badly, and soon. If they can't be had peacefully, they will be had violently.

The question is: How do we get it done peacefully? . . . We know what [the problems] are: urban problems, education, health, welfare, pollution, crime, traffic, dirt, crowding, and all the rest . . . If you don't like what the Federal Government is doing with our money . . . complain . . . complain to everyone in authority every chance you have. It sounds rather trite to say write letters, but if there are enough of them, they really do work . . . If there is a political candidate, . . . [whom you] approve, give him a little money, work for him, and vote for him. If there is no candidate, find one and persuade him to run. If you can't find one, run yourself. That is the only prescription for peaceably forcing the changes we need without destroying everything in this country that is worth having.

---David Brinkley
NBC News
from a paper prepared for Project 70's, sponsored by Schenectady, New York, Public Schools and NEA

WHAT DOES IT DO TO JOHNNY?

A COGNITIVE-FUNCTIONALISTIC VIEW OF RESEARCH ON MEDIA

gavriel salomon

PROGRESSING TOWARD a theory of instructional media, I shall take the view that sound research in instructional media needs to fulfill at least three conditions.

1. Research on media needs to generate a framework of *valid questions* to be asked. Questions which are interlocked with other questions and which are based on valid assumptions provide guidance and direction to research. As we know, too many of the questions which were traditionally raised in the field of research on media were based on erroneous, or indefensible grounds, and hence led to invalid answers (20).

2. Research on media needs to be closely related to research in other areas such as human development, individual differences, information processing, etc., and to become part of them. Unfortunately, most of the known research in media is quite unrelated to any of the better established areas of research, as if to imply that media research is a new field or a new discipline requiring an independent and unrelated place in the world of scientific inquiry.

3. The third condition is that research be done in a theoretical framework. This point means that our research *conceptualizes* rather than just tests new devices and novel modifications. The ultimate goal of research is *understanding*. Without this we have a mere accumulation of devices and "significant differences" which add up to very little. This is the case when we do not know *why* one thing works and why something else does not; why something works in one case but does not work in another case.

It is high time we divorce ourselves from the immediate application and the testing of devices which were our major foci until recently, and concentrate instead on *laying the foundations for a theory of instructional media.* To echo Cronbach at this point, *the only practical approach, for us, is to search for interrelated explanatory principles* (6).

Now, what is this theory I am talking about? It is, in my opinion, subsumed under a wider theory of instruction. Such a theory, to follow Bruner, needs to be prescriptive, rather than just descriptive; *it concerns itself with the relationship between how things are presented and how they are learned.*

When we speak of a theory of instructional media we have in our minds the optimal way of presenting and arranging information, which can be carefully controlled and managed. Such control is apparently best achieved with the help of mechanical and electronic media. Moreover, certain overt or covert behaviors, can be aroused, guided, shown, modelled, etc., by no other means than those called "media." But just knowing how to control, guide, etc., is not enough. The theory must also provide *explanations* for the interactions between learner and stimuli. We thus search for some optimal and well understood matches between kinds of stimulation and educational outcomes.

This, however, is far more complicated than it seems.

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Previous attempts to prescribe such matches, e.g., Gagné (8), were not very successful because there were no psychological justifications to pair certain modes of presentation with educational outcomes. Two factors contributed to this deficiency.

1. The first was to find psychological justifications for matching say, pictorial presentation with certain kinds of learning outcomes requires, by necessity, the analysis of the mediating processes within the individual. And this is rarely provided.

2. Once the analysis of mediational activity takes place, inter-individual and intra-individual differences need to be considered, and the much too frequent search for some universal simple rules of matching becomes impossible.

Since, however, a theory of instructional media cannot be constructed without the search for specific stimulus-learner-task matches, there is a clear need to turn to contemporary psychological inquiries into cognition. To establish such a change, questions must be formulated in terms of the interaction between stimuli and cognitive functions.

A cognitive-functionalistic view

Granted that our research is theory-oriented, it not only

predicts and controls, but also attempts to explain. It is common practice in nearly all branches of behavioral science to ask not only what goes with what, and under what conditions does this or that take place, but also *why* the phenomena occur. This tendency, I think, is common to nearly all researchers, including those of the neoassociationistic school, e.g., Berlyne, 1965; learning, e.g., Melton, 1964; the verbal-learning research, e.g., Mandler, 1967 (3, 17, 16), and, obviously, research in the Piagetian tradition. Once there is an attempt to explain, there is an inevitable need to enter the "black box."

Attempts to study mental processes are as old as psychology itself. Unlike attempts in the past, however, there now are more advanced methodologies and tools of inquiry which enable the researcher to bring mediational activity under his control (e.g. 10, 25).

Contemporary researchers become more and more concerned with the *functions* of stimuli, conditions, instructions, etc. (27). They do not only look for statistically reliable connections between stimuli and responses, but also add the questions: What does it do to the subject? What is the *psychological* situation we create? Asch (1), to provide one example, writes: "Given the operations of relating, it follows that the nature of psychological stimulus is the first problem in the study of learning and memory. It is necessary to distinguish between the external and the psychological stimulus conditions. Activities of relating have their correlates in objective conditions, but they are not a copy of these conditions." (1:97)

We become more and more aware of the fact that the physical stimulus, taken alone, accounts for only a very small portion of the response domain. The same stimulus is differently perceived, decoded, processed, etc. by individuals who differ on a number of relevant characteristics. Thus, the way they overtly handle the stimulus may have more influence

than does the physical stimulus itself on the way they overtly respond to it. We thus turn to a conception of human behavior which can be crudely characterized as a three- (instead of two-) stage process:

S - r - R

where the stimulus (S) is responded to by covert processes (r) which in turn lead to the final response (R). Yet, it is the mediating behavior, r, which we are trying to affect. Our major assumption is, to quote Ausubel that *"teaching itself is effective only to the extent that it manipulates effectively those psychological variables that govern learning."* (2:12) And this means, understanding the cognitive functions that particular modes of presenting information may accomplish.

This seems to be in line with the emerging trend in educational psychological research today, and I think that research in media should link itself to this. The questions asked must be linked to such theories and lead to a new theory which nourishes and is in turn nourished by these theories.

Media from a cognitive-functionalistic point of view

At this point, one would justifiably raise the question: What is that mysterious "media" with which we are dealing? We have opposing views ranging from McLuhan--The medium *is* the message--to Carpenter, who states that ". . . it is the content of the stimulus material (in psychological terms) and its very special value for the individual learner that is important and not the particular carrier of the information." (5:236)

Scattered observations can be provided to support equally well both premises. Yet, it is difficult to deny that extracting information from, say, maps calls for a different set of mental processes than extracting information from a

photograph of the same terrain. It is not unreasonable to expect that the ways messages are shaped by their carriers do require different strategies of approach on the part of the learner.

But not all physically similar modes of presentation function psychologically in the same way. Likewise, not all similar psychological functions are stimulated by the same kind of stimuli. For an analogy, see the discussion of language behavior by G. A. Miller. (19) *Some* correspondence between shape of stimuli or modes of presentation and, say, information processing will certainly exist. But this correspondence is only a partial one, and its degree will vary according to the restrictions imposed on content and its organization by the carrier of the information. Thus, for instance, maps are far more restrictive in this respect than are films, for example. Consequently, different maps will be quite similar to each other in terms of their psychological functions. Not so films. Their range of shapes, kinds of content, ways of arrangement, and other individual variation is so wide that to speak of the "effects of film" *qua* film makes little sense.

I propose, therefore, that we define an instructional medium as the intersection of two variables: physical similarity of psychological functions, i.e., *an instructional medium is a package of unique modes of presenting information* (which may or may not be a consequence of some attributes of a machine) *which also fulfills a unique psychological function.*

If pictures in a book, on the screen, and in a film turn out to fulfill the same psychological function (given common learners), then they are one instructional medium. If, on the other hand, they function in different ways and thus do not fulfill the second condition, then they can not be treated as one instructional medium. It should be clear, though, that we refer here to the *unique* psychological functions that a well differentiated mode of presentation *can* accomplish,

given certain materials, tasks, and learners. A wide screen and a narrow screen may have the same effect on information processing with one kind of materials and under a specific set of instructions. They may, though, have entirely *different* effects if we use them to convey different kinds of information, each of which being uniquely suited for one of the modes of presentation. But even if the material is the same, the different modes of presentation may have different effects when they arouse different mediating processes which are not equally relevant to the learning task at hand.

In sum, the conception of a medium is quite complex. We define an instructional medium as the overlapping area of two circles: the stimulus-attributes circle and the response circle. When various stimuli have common structural attributes which do not call for common cognitive responses, they cannot be said to constitute one medium. However, when such stimulus attributes call for a common core of mediators which is clearly different from the core of mediating responses called for by stimuli who share other attributes, then, and only then, can we speak of an "instructional medium."

Obviously, any kind of presentation accomplishes many psychological functions by arousing and activating numerous mediating processes. Most of these, however, can be accomplished by many other modes of presentation. If, as Pryluck and Snow state, the most important message of a film is on its soundtrack, why should it have any different effect than, say, a lecture? (23) What concerns us here are the *unique* characteristics of a mode of presentation and their *unique* psychological effects. As stated above, when these two exist in a lawful way, it becomes possible to speak of an instructional medium.

There is a clear difference between the cognitive processes aroused by a stimulus, and their relevance to learning of a specific nature by a specific learner. This means that unique effects on learning will be observed only when

the medium attributes under examination have a *central function which is relevant to the learning of X by Y.*

Here, then, we introduce two additional factors which have little to do with media as the sole function of common shapes of messages: These are *the learner and the task.*

Once we introduce these factors the following occurs:

1. We move *away* from the controversy of medium vs. message, since if a certain attribute is cognitively relevant to only certain persons under certain task requirements, what sense does it make to deal with the medium *alone*? For instance, the effect may even result from the darkness which accompanies the viewing of a film at a time when it allows less restricted expressions of emotions and when these are relevant to the learning objective (18).

2. We concentrate on the triangle: learner, task-specific processes, and stimulus.

3. The stimulus which we study is viewed as doing something to the cognitive processes of somebody under certain motivational and instructional conditions, regardless of whether it is considered a message, a medium, or a channel; whether it is a sign, sign vehicle, or a signal.

Some questions that research needs to deal with

At this point we have to distinguish between research *on* instructional media and research *with* media. The former deals with *the unique cognitive functions that unique modes of presentation can accomplish.* And this area has hardly been dealt with. The latter is research in learning which happens to use media as a source of stimuli but does not tell us much about the functions of media as defined here. We know many studies which utilized films, televised presentations, or other modes of stimulating. But using some mechanical or electro-mechanical tools in a study does not qualify it as research *on* media. Carpenter, to take one example, states

that "the central problem, as far as new media is concerned, is that of determining how they can be best adapted to meet the requirements for effective academic learning." (5) This is fine. Yet then he goes to study whether programmed instruction can be adapted to CCTV and other media. However, such research turns out to be concerned solely with programmed instruction, not with "new media," since one loses the unique effects that could have existed. What do such studies tell us about the *unique* functions that CCTV can fulfill that a text *cannot?* Sure enough, Carpenter's study shows that programming is effective. Was not it known before? We would be astonished if the results did not turn out as they did.

When I speak of research *on* instructional media I refer to these aspects which were left out much too often. What I am proposing is not research on learning nor is it "pure" research of cognitive processes or communication. It is an inquiry into *the relations between unique media attributes and their unique psychological functions under specific task requirements and specific learners.*

In light of all this, what kind of questions would we have to raise? Consider the following series of illustrative questions?

1. What are the physical elements which are unique to different media and which may have some unique influence on learning? (The assumption underlying the question is that no medium *qua* medium has some built-in mysterious effects which are universal.)

2. What is effected by these elements? (In this connection, recall one of Hilgard's remarks that in programmed instruction it is not the final overt behavior that we actually reinforce but rather the covert behaviors which produce it!)

3. What unique patterns of influence can we introduce with these elements? (Implied in the question is the possibility that stimuli can do more than <u>just</u> reinforce, cue, probe, or arouse.)

4. Under what kinds of task conditions does a potential influence become realized? This is to say, when do unique media elements have a specific influence on covert behaviors which are also relevant to the attainment of the learning task at hand?

5. Who is to profit from the impact of certain elements and who is to be hampered? (See Snow's paper, pp. 63-89, for an extensive discussion of this point.)

Questions of this sort impose, of course, tremendous complexities. It would seem, though, that unless they are answered, there cannot be much progress in media research. Posing questions, obviously ties research on media to research in cognition, learning and development, etc., yet it is not identical to them.

What kind of generalizations can research along the five proposed questions lead to? Similarly to what we see taking place in adjacent areas--e.g., learning by Discovery (7)--our generalizations will be rather specific. Once we move away from universal questions like "does ETV produce better learning?" we cannot but aim at much more limited conclusions. As it is implied in the above list of questions, no generalization refers to one nicely isolated variable. Rather, it incorporates developmental, cognitive, informational and task-relevant aspects. Thus a generalization of the sort I suggest would look as Table 1.

As you will notice there are here three major components: the medium-message dimension, the psychological task requirements and the learner's characteristics. This, of course, appears to be quite complex. But, is not the whole process of instruction rather complex? It is interesting to note that many teachers, producers, and communicators think along such complex lines although they do not put their thoughts in lengthy statements of the kind proposed here. For instance, when a producer of commercials plans his ad, he has

The Medium (film / : / computer) is capable of presenting (/ : /) unique kinds of messages,

which in turn can fulfill the psychological function of (arousal / : / supplantation / : / reinforcement) of the

mental processes of (comparing / : / relating / : / identifying) which in turn are needed by learning tasks of

(/ : /) sort for a learner of (/ : /) mental or emotional characteristics.

TABLE 1. Sample generalization based on five proposed questions for research on instructional media.

a very good sense of what kind of emotional, perceptual, or mental processes he wants to arouse in what kinds of audiences, and how these processes relate to the final behavior (buying, consuming) that he wishes his audiences to undertake. When the producer of commercials shows a famous actor drinking a certain kind of beer, he assumes that some identification and hence imitation will take place and that these processes, in turn, will facilitate the viewer's choice of behavior when faced with a selection of brands.

Let us now examine a bit closer what is implied by the five questions proposed for research:

- What are the influential elements?
- What do they influence?
- How do they influence?
- When does the influence facilitate learning?
- Who is to profit from these influences?

The questions are clearly interrelated and it would be quite difficult to answer one of them within the framework of one study without making some assumptions about the others. What these questions imply is some kind of a grand matrix composed of three dimensions: modes of information presentation, learning tasks, and individual characteristics. Modes of presentation can, hypothetically, be grouped according to our two criteria: physical similarity, and psychological function. Learning tasks need to be classified according to the kinds of mediating processes which underlie them rather than according to what Melton called the "primitive operational categories of learning." (17) The third dimension, individual differences, is by its very nature a classification based on mediating processes.

The cells of this hypothetical cube are those points in which a specific mode of presentation accomplishes certain psychological functions (i.e., influences specific mediators in some way) which are also required by a certain type of learner for a certain class of learning tasks.

Let us take one example. Sieber (1968) wished to find a way to overcome the debilitating effect that high levels of anxiety have on learning. (26) First, it was found that debilitation takes place mainly in complex learning tasks. Second, it was suggested that one common attribute of such tasks is their reliance on memory of previously executed moves which lead up to a solution. Anxiety, it was hypothesized, affects learning indirectly: it actually interferes with retention of the intermediate moves and their consequences, and through them affects the observable attainment of a solution. Sieber hypothesized that if highly anxious Ss are provided with visual stimuli which retain the necessary information for them, so to speak, then no debilitating effect will be observed. In the experiment, high and low anxiety Ss were faced with a rather complex task. When no "memory supports" (drawings of already executed moves) were provided, the former out performed the latter. However, high anxiety Ss performed as well as low anxiety Ss when "memory supports" were given.

This study illustrates the idea about the intersection between the three dimensions of the hypothetical cube. Certain tasks (e.g., complex problems) call on certain mediators (retention of intermediate moves), with which certain Ss (high anxiety ones) have difficulties. A particular mode of presentation (pictorial representations of the moves) accomplishes a specific kind of function (providing a substitute for the unretained details) which in this class of tasks and for these learners facilitates learning. One moves away from this class of tasks and for these learners facilitates learning. If one moves away from this class of tasks to one in which memory of intermediate moves is unnecessary (e.g., learning foreign words), "memory supports" should not serve any relevant function. Similarly, move away along the individual differences dimension to other Ss (low anxiety ones) and, again, no relevant function has been served.

In sum, the five questions raised are interlocked and

one is no more primary than another. Sieber, in the study described above, started by analyzing the influence of anxiety on problem solving; then proposed a mode of stimulation to circumvent this influence. Wicklegren and Cohen also studied the functions of "memory supports" but their points of departure were the analysis of concept formation as a mental process, and individual differences in memory capacity. (29) To take a third example, Salomon studied the psychological processes aroused by two modes of editing a film. (24) The point of departure was the stimulus and its functions.

Common to all these examples is the overt or assumed reference to the three dimensional cube where stimuli, tasks, and individuals interact. The uniting tie is the psychological function that is relevant to a certain learning task and which is accomplished by particular modes of presentation.

What does it do to Johnny?

Of the five questions we have raised, one appears to be of central importance. This the question which deals with the kinds of psychological functions that different modes of presentation can accomplish. It would be impossible to treat in any honest way all the questions raised up to now, yet one cannot avoid discussing this one. To claim that knowing that this or that element has some effect on a certain mental activity under particular conditions, is quite important. However, real understanding of the instructional value of media can be achieved only if we have some insights into the nature of this influence. In other words: when we understand what a particular kind of presentation actually does to the mental processes of the learner.

It has been claimed in the past, e.g., by Salomon and Snow (25), that the use of a certain mode of presentation will have a significant effect on learning only if it *arouses*

or *supplants* mental processes which are relevant to the learning of a specific task. This is very much in line with Ausubel's idea about effective teaching, which we have quoted earlier, and is supported both by logic and by some empirical data. Obviously, arousal or supplantation of task-relevant mental processes are not the *only* functions one could think of. Visual, verbal, and audio-visual stimuli can also reinforce, inform, cue, guide, surprise, etc. and it would be desirable to study the ways in which stimuli accomplish these functions (see, e.g., Gropper, 11). Here, though, I would discuss in more detail the function of supplantation, mainly because it seems to be a unique potentiality of particular media. It is one way to influence learning, and a rather interesting one.

To supplant mental processes means to *execute them explicitly for the learner.* A mental process is supplanted when an analoguous process is overtly executed in front of the learner's eyes. Thus, *supplantation is the function accomplished by an explicit presentation of what would otherwise have to be done covertly by the learner himself, such that a certain learning objective will be attained.* When, for instance, we show, in a film in which a globe rotates, when we "split" an apple to show "halves," or when we show how a mountain changes its shape and is viewed from above, etc., we apparently supplant the mental processes of, say visualization. It is quite reasonable to hypothesize that if learning of the year's seasons, of fractions, or of maps is based (among other things) on the visualization of rotation, splitting or changing physical appearances, then explicit demonstration of this sort ought to facilitate the acquisition of the information.

Similarly, one could think of a way to supplant some of the major processes which underlie, according to Piaget, the conservation of the volume of liquids. Both reversibility (pouring water back into the original jar) and coordination of dimensions (the "fat" jar becomes "thinner") can be shown

explicitly with the aid of filmic techniques, thus supplanting the mental processes of reversibility and coordination.

This analysis is based on two assumptions:

1. Signs and symbols have a dual function: they are used in overt acts of communication to affect a receiver's behavior, and they are used in a covert representational capacity to guide one's own behavior. (3) We can communicate overtly as well as stimulate and regulate our own behavior by using the same or similar signs.

2. Information to be learned is composed of events, signs, and their transformations. These, we believe, can be stored, integrated, generalized and used as internal symbolic stimuli and responses of two kinds: *situational and transformational*, or, as Inhelder calls them, figurative and operative aspects of cognitive functions. (13) Situational symbolic responses are internalized representations of objects and events or of responses related to them. Transformational responses are internalized representations of activities which modify, manipulate, and transform the objects and events. (3, 22)

The internal, representational signs and symbols (what we have called the covert situational and transformational behaviors) have a manipulatory origin: They develop from prolonged daily contact with concrete objects which we manipulate. (15) Later they become iconic and finally they take on symbolic shapes. (4) At the same time they also become organized into groups, schemes, etc. Once they are internalized they can assimilate increasingly more complex responses without the necessary overt manipulation of objects. Thus when the child grows older he does not need to *manipulate* everything new he is to learn. He can learn--i.e., internalize for representational purposes--signs and symbols which are overtly presented to him by other sources.

These two assumptions lead us to hypothesize that

supplantation of mental processes can serve in two capacities:

1. It can provide compensation for what the learner cannot execute mentally on his own, hence aiding him in attaining a particular instructional objective.

2. It can offer him an image of a situation or of a transformation to be internalized, stored, and made available for later use in a covert form.

Some evidence to support the two hypotheses can be found in the literature concerned with learning by imitation, as studied by Bandura and his associates. Other evidence can be found in some recent successful attempts to modify through training and explicit demonstration children's conceptions of conservation, space, casuality, etc. (e.g., Sullivan, 28).

Common to Bandura's work and to the Piaget-inspired research are the attempts to modify behavior (social or mental behavior) through the explicit demonstration of behaviors which are assumed to underlie the final behavior. The relative success of such studies lends support to the hypotheses stated above. Yet, this would be a slight oversimplification of the matter. For one thing, there is some evidence to show, as Berlyne indicates, that "images representing transformations do not occur simply as a result of witnessing the transformations in questions." (3) Such transformations are not learned, until the learner can assimilate them into his cognitive structure, hence give them "meaning." (2)

These points, therefore, tend to suggest that explicit presentation of mental processes will function in a supplanting capacity only when two conditions are met.

1. The presented information is sufficiently explicit, thus provides enough supplanation of the mental processes necessary for an item to be learned, a concept to be attained or a principle to be formulated. Here, then, we are concerned with the *amount of supplantation*, i.e., how much mental

activity is left for the learner who has been given a specific learning task.

2. The presented information is sufficiently close, with respect to its semantic and contextual nature, to the learner's cognitive structure. Showing how a jar changes from "fat" to "thin" to a very young child may not facilitate the acquisition of conversation. Nor will it facilitate the understanding of the processes involved, simply because the child is still in need of manipulating objects. The explicit presentation, in this case, does not supplant any mental process which comes close enough to what the child would have to execute. The same applies to adults as well. As Kohlberg points out, "concrete operational thought, or even sensorimotor thought does not disappear when formal thought arises, but continues to be used in concrete situations where it is adequate or when efforts at solutions by formal thought have failed." (15:1021) Therefore, an abstract explanation of transformations which occur in space flights, even if very explicit, does not supplant any relevant process that the novice would have used, or could have incorporated into his conceptual scheme.

Here, then, we can speak of *the nature of the supplanted* as complementary to the former dimension.

Supplantation is not an all or none function. For the sake of this discussion imagine an act of thought as composed of three links: the initial situation (s), the transformation of that situation (r), and its final form (R). S, r, or R may be highly specific or very general (a "rule"); they may be overt signs or internalized representations; each may be a single unit or a composition of more specific components.

When we examine the continuum ranging from least to most supplantation, we can identify various points. One may attempt only to *induce* the necessary mental activities by showing nothing but the beginning state of a process. This could be the case when we show the learner how X looks

and ask him to compare it to an absent Y. It appears quite often in discovery learning studies under the label of "discovery condition" or "rule not given, example not given." Here, obviously, we assume that the learner has the necessary mental processes in his response repertoire, that they are not easily accessible, and that the degree of response uncertainty aroused in him is not beyond his tolerance.

The "visual task" is significantly reduced when only the initial situation is presented. The major burden falls on the "mental task," to use Perrin's terms. (21) This may be the best way to train learners in executing certain processes, yet it may not be the best way to acquire a new operation or item or an extension of those. Granted, however, that the learner is capable of executing a process of comparison, negation, coordination, and the like, allowing him to execute it on his own (thus being least explicit) may be just the right amount of supplantation. When Perrin suggests the use of simultaneous multiple-images, which according to him ought to induce processes of comparisons, he is assuming that doing it for the learner would only be redundant and restrictive. (21) What we know about the relationship between uncertainty and change (14), incongruity and change (12), etc. lends support to this assumption. The kind of processes induced and the amount of uncertainty aroused will depend also on the task to be performed. A sketch may be all the information needed when only the outline of the object is to be learned. It may require a very long chain of mental processes if the objective is to extrapolate from it.

When we move a bit further on the continuum of amount of supplantation we find the presentations that short-circuit the necessary chain of mental transformations by presenting the initial situation and its final modification (the way it looks after being transformed). We short-circuit the process because we do not show it, yet we expect the learner to select from the storage of processes at his disposal the right transformations.

Programmed instruction, for instance, uses this procedure but it also breaks down each and every link in the chain to very small units that supplanting the intermediate transformations appears to be unnecessary. Bright students, as many studies tend to show, prefer a somewhat less explicit presentation. They seem to be better off with a situation that does not short-circuit each move for them. At any rate, what is required of the learner is to select a certain transformation so that the initial and the final situations will be tied together.

Toward the other end of the continuum we find the presentation which provides the initial situation and its transformation, and the learner is expected to *apply the transformation* to the situation. Here, less selection needs to take place. The most important link--the process of transforming--is overtly shown.

Finally one finds the presentation which attempts to be most explicit, thus to *supplant as much as possible*. Here S, r, and R are provided and very little is left for the learner to fill in. He is expected to incorporate the chain of transformations, store them for later use and formalization.

Imagine that we begin with a collection of objects (S) and want our learner to group them according to some common attributes. Imagine also that we have some intuitive or empirical reason to believe that to do so, our learner has to choose one attribute of one object (e.g., round) and check according to some pattern (e.g., scanning) whether it exists in other objects as well. Finally, if the answer is positive he "moves" all the objects which are round to one imaginary side and the remaining ones to another. These three steps are then the alleged mediators (r's), and the final grouping is the solution (R). We may now show the collection of objects, focus the camera on the roundness of one object, move to the rest and then let the round objects "move" closer to each other. We have shown explicitly the whole process.

Given a learner who has the concept of "round" in his repertoire, we would hypothesize that this presentation would supplant the whole process for him. The *whole* process? Probably not. If covert verbalization takes place (as studied by the Kendlers, for instance), then this act has *not* been supplanted. However, knowing that verbalization takes place, one can short-circuit it as well, by providing ready-made labels.

We might have done less for the learner. We could have shown him the objects (S) and the groupings (R) without showing the transformations in between. This would have short-circuited the process. The learner would have had to select from his repertoire a suitable chain of transformations to close the gap; or we could have begun with S and then have shown the r's but not the resultant situation (R). Here we ask the learner to apply the explicitly provided transformation to the initial situation to come up with the final R. Finally, we could have provided him with S only, leaving all the rest for him. The function of this would be to induce in the learner appropriate mediators.

Recall again Sieber's study about "memory supports" (To repeat the description of the study would be to "short-circuit" the process of recall, which seems to be unnecessary here for readers with a good memory or for readers who are familiar with the study). What did the "memory supports" do to the subjects? They have apparently short-circuited overtly each move in the process of solving the problem.

The question still exists as to whether we actually supplant mental processes or whether we only substitute for them. If only the latter is done, then, of the two functions that explicit presentations can serve, only the first can be accomplished. We would be able to compensate for deficiencies by doing for the learner (e.g., selecting an item out of a context) something he may have difficulty with. We would not be able to provide him with an image of an

operation or a situation which he could then later apply internally. We are now engaged in a study in which we examine the effects of various amounts of assumed supplantation on immediate understanding of a message and on transfer tasks. The process we attempt to supplant is the visualization of transformations in space. Our early results show that both objectives are better achieved with a moderate amount of supplantation. We find also support for the hypothesis that our Ss have actually incorporated the presented transformations and applied them in new problems. Thus, real supplantation may be possible.

When we attack the question of supplantation from the point of view of *what* is supplanted (actually turning to the second question in the five-question list we have proposed), we face entirely new problems. An explicit presentation of a process which does not underlie the learning-task at hand could not be expected to facilitate its attainment. Similarly, it is rather important whether the supplanted process fits, or does not fit, the learner's mental structure. Thus, to be able to design a presentation so that it will actually supplant particular mental processes and facilitate the acquisition of bits of knowledge, we need to know something about the nature of the processes underlying the task at hand, as well as the cognitive nature of the learner. This is one of the reasons why research on media needs to be closely linked with research on cognition and development.

Gentile and his associates, while studying whether associational processes that underlie solving analogy items, did, actually, supplant the process of finding an association in one of their experimental treatments (To be more accurate: they short-circuited the process by providing an association). They conclude the report by stating that "Relationships [which are given to the Ss] which are congruent with those that S would have generated by himself . . . facilitate performance on analogy items." And conversely with relationships

which are incongruent with those S would have generated by himself. They also found that when E short-circuits the process, S will not generate his own relationship. This, then, should not facilitate transfer since S is not given any practice opportunity. (9)

For instance, ordering informational items into models, schemes, etc. may facilitate their retention (see for a detailed description Fleming's paper, pp.). When the items "organize themselves" in front of the viewer, the presentation may not only facilitate retention but also supplant the process itself. But will it lead to an improvement in the *ability* to categorize items? It is one thing to facilitate the understanding of, say, a principle by supplanting the underlying mental processes. It is another thing to expect a transfer effect. Does seeing specific transformations, instead of executing them covertly, have any generalizable effect? This is a question to be answered by research.

Let me now return to the question of research on media. It seems quite clear that media differ with respect to the amount of supplantation they can provide and with respect to the nature of the processes they can supplant. Some media can show how things look and how they change; these media, like film, seem to be best suited to supplant iconic processes. Other media, like maps and models, cannot show any transformations at all. Some media can show situations as they appear in reality while others can create contrived or fabricated stimuli which contrast or distort reality. It may very well be that the latter cannot only supplant processes which one could have acquired otherwise, *but provide images of situations and transformations which could have never been acquired without them.*

The distinction among media is quite different when it comes to the nature of the supplanted processes. While movies can supplant concrete transformations, language does it on an abstract level; and while a map can arouse iconic

mediators concerning the relations between geographic elements, a graph can do the same on a symbolic level. A real model can arouse actual manipulatory activities while a drawing of the same apparatus does it on an iconic level. One thing, though, is clear: not all processes can be supplanted pictorially or verbally. *However, it is the contrived ways of presentation which may provide supplantation of processes unthought of until now.*

All said, the function of supplanting mental processes seems to be quite relevant to the study of the psychological functions of instructional media. Now we could ask questions of various types: How do I supplant best this or that process? What processes does this or that mode of presentation supplant? Under what conditions does supplantation of this or that process, when done by means of a certain medium, lead to such and such outcomes? Who will profit from the supplantation of this or that process done by means of a certain medium, and who will not? What learning outcomes can be expected if we suuplant a certain process by means of two different modes of presentation? etc.

The discussion above does not imply that all that media can do is supplant different processes in various amounts and on different levels of abstraction. Thus, one faces the need to study the relations between supplantation and other functions (e.g., cuing) as well.

Some implications for research

To recapitulate, research on media needs:

1. To relate itself to research in other fields.

2. To nourish other theories and, in turn, be nourished by them.

3. To deal with the *functions* of stimuli.

When one goes now to conduct a media study with these points in mind, he obviously needs to know something about--

1. the nature of the processes which are to be learned.

2. the degree of mastery that his subjects have of the specified aptitude or related (possibly, more general) ones.

3. the general level of mental activity of the subject relative to the material to be learned.

Given this information, the experimenter will have to decide how much uncertainty he wishes to arouse, how much, and what kind of, independent activity he wants to allow, etc. But these prescriptions sound as if taken from a book entitled: *The Impossible Research Procedures . . . .* Therefore, let me provide an illustration.

Assume we found that the more reflective teachers turn out more reflective students, and that the ability of "self-examination" correlated with reflectiveness. It would seem desirable to increase the reflectiveness of low-reflectivity teachers. We choose to improve their self-examination-ability to meet this end. We hypothesize, by the way, that this ability underlies reflectivity and that improvement of the former facilitates the latter.

We thus decide to induce processes which constitute the self-examination ability. But how do we induce them in subjects who are deficient in them? We decide to supplant some of the components of the process so that they will be incorporated and used, i.e., we tell the poor self-examiners how they actually perform. This may arouse quite a bit of conflict, as previous work concerned with the confrontation with one's own behavior tends to suggest. Providing a verbal description which is expected to supplant the process of self-examination implies that individuals really examine themselves verbally, and this may be wrong. And if it is wrong, then we may induce more transformational activity than needed and defeat our purpose. Thus, we devise an alternative way of supplantation, namely, by using video-tape

recorder. This may provide signals on a level closer to the one people actually use to examine themselves.

We set up an experiment. Teachers of all levels of self-examination ability are included, and three treatments are given: visual-concrete supplantation (self-viewing on VTR), verbal-abstract supplantation, and arousal. In the first condition Ss see themselves on the VTR, in the second they listen to a verbal description of their behavior, and in the third they are told that they performed poorly--and will be required to "examine themselves," thus creating an arousal condition.

So we compare two procedures of supplantation that differ with respect to their relations to the images one tends to use in such cases, and a third procedure which is supposed to induce the relevant processes. *Note that we know very well why we chose each of the stimuli.*

After administering these treatments we measure differences on a number of dimensions. Let us take a look only at reflectivity--the correlate of self-examination. We find that the VTR treatment is on the average as successful in improving the Ss reflectivity as the arousal condition, and that both are better than the verbal-supplantation condition. Since there is improvement in reflectivity--we can support our hypothesis that the process of self-examination underlies reflectivity. We have nourished research in a field which also nourished us.

But then we examine the interactions between our treatments and self-examination aptitude measures which we took at the beginning.

We find, as one would expect, that only the better self-examiners profitted from the arousal condition. Hence, it did induce in them the relevant processes. For the poor self-examiners, this treatment aroused too much uncertainty.

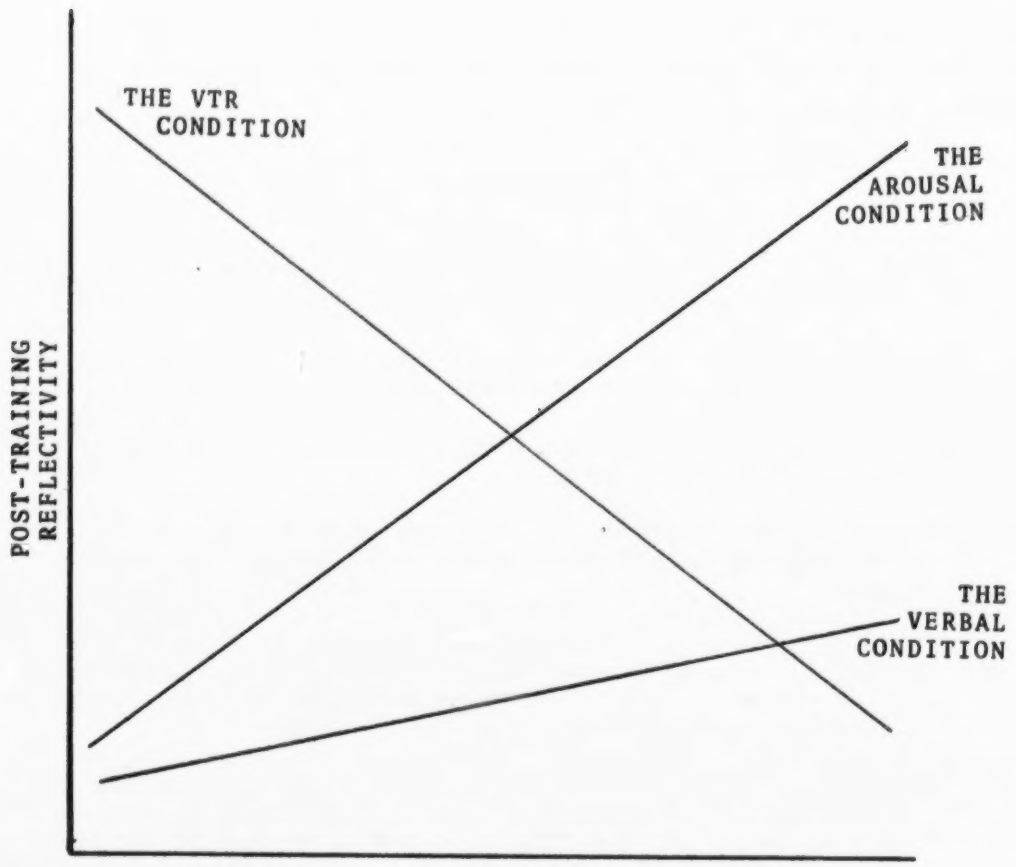

Fig. 1

However, the latter profitted most from the VTR presentation. It supplanted something on the right level. For the good self-examiners, VTR was too concrete; they perform perhaps on a verbal rather than pictorial level and profit therefore from the abstract.

This, of course, is just an hypothetical illustration. But it highlights the approach I wished to present. Such a study tells us quite a bit about the functions that self-viewing on VTR can accomplish, with whom, and under what conditions. This is not to say that other functions cannot be accomplished. But most of them can be done equally well by other media. Moreover, such a study does not only prescribe the best uses for a medium, it also helps us in understanding

the reasons why an effect is produced. This, in addition, is tied to a conceptual schem- and some new hypotheses can now be deduced.

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But many of us fail to realize that communications is not concluded when knowledge is disseminated. This is only one-third of the process. Communications involves disseminating information, getting a response and evaluating that response.

---*Floyd Christian, Florida State Superintendent of Education, quoted in Public Understanding of Education as a Field of Study, p. 12*

RESEARCH ON MEDIA AND APTITUDES

richard e. snow

IN A PREVIOUS PAPER by Salomon and Snow (18) an interactional approach to research on media was proposed. Following the lead of earlier work by Cronbach (4, 5) it was suggested that combining the ideas and methods of experimental and correlational psychology offered the possibility of differentiated instructional improvement in place of a continued, fruitless search for the one best way to teach everyone. The new approach would assign learners to different instructional treatments tailored to fit their own particular strengths and styles of learning. A few examples of the interacting effects of selected aptitude variables in gross media comparisons were discussed and some rough guidelines for further work were sketched.

Since that time, a fairly comprehensive, though not exhaustive, survey has been conducted of interactional studies in instructional research generally (6). Some new data on media variables have also been collected. The purpose of the present paper is to review these developments and to

elaborate more fully the general approach and tactics suggested for interactional research on media. It is hoped that such discussion can identify a number of hypotheses worth testing in future work, though it is acknowledged that such hypothesizing must be frankly speculative at the present state of our ignorance.

The General Problem

First, it will be helpful to review the definition of aptitude-treatment interaction (ATI). A basic definition comes directly from the method of analysis of variance; an interaction is present when an effect found for one kind of subject or in one kind of setting is not found under other conditions. The focus here is on interactions which involve at least one aptitude variable, representing some specified individual difference among learners, and at least one treatment variable, representing some specified or experimental manipulation of theoretical or practical interest. To be properly interpreted, such interactions must be represented in terms of a regression analysis displaying the relation between aptitude and the learning criterion separately for each treatment. Interaction is present when the regression lines for separate treatments are judged nonparallel, using a standard F or t test for equality of slope. It is helpful to specify two classes of such interactions: *ordinal* and *disordinal*. As shown in Figure 1, a disordinal interaction is one in which the regression lines for treatments intersect somewhere within the range of the aptitude variable under investigation. Assuming that the two treatments are alternative instructional media or methods, the presence of disordinal interaction indicates that persons with aptitude scores to the left of the intersection point should be assigned to the other treatment. In the figure, the light vertical line through the regression intersection shows where the aptitude continuum would be divided. By placing high aptitude students in Treatment A and low aptitude students in Treatment B, maximum learning outcome for each individual is obtained. Note that there is no average

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difference between the treatments and hence no one best method for everyone. An ordinal interaction occurs when the regression lines have different slopes but do not intersect within the aptitude range. In the example, Treatment A is thus best for everyone. While not of primary interest therefore, an ordinal interaction could be practically useful where the better treatment is more costly than the other or involves a quota on group size or other such limitations. Then, the learners who most need the costly treatment are assigned to the second treatment. An ordinal interaction may also be of theoretical value for further ATI work if the aptitude variable can be conceived as extending to a point of regression intersection somewhere to the left or right of the range under study.

With this definition in hand then the aim of ATI research in education can be stated as follows (6):

> Assuming that a certain set of outcomes from an educational program is desired and considering any particular instructional treatment, *in what manner do the characteristics of learners affect the extent to which they attain the outcomes from each of the treatments that might be considered? Or, considering a particular learner, which treatment is best for him?*

ATI research in media is deemed particularly important in

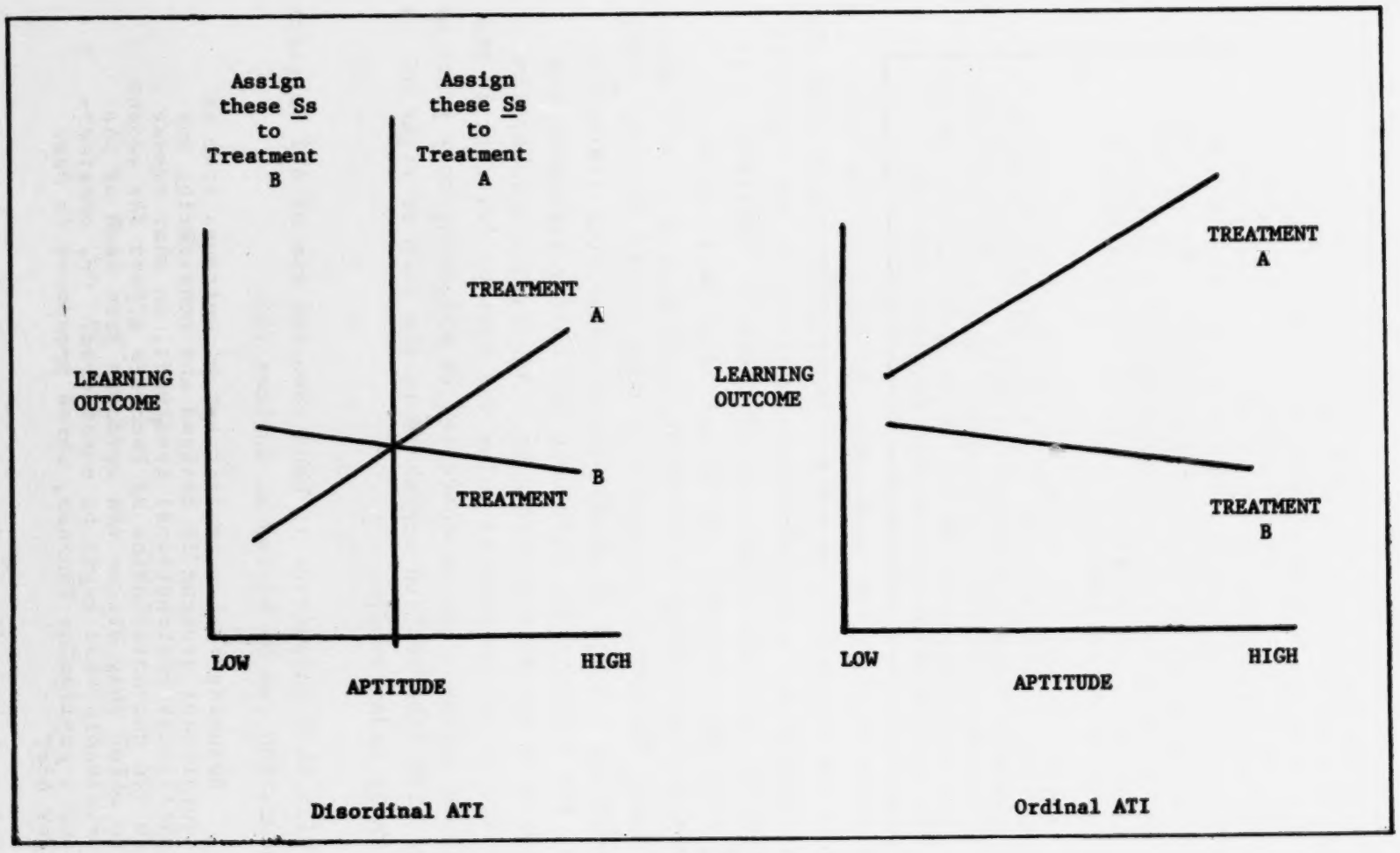
Assign these Ss to Treatment B
Assign these Ss to Treatment A
LEARNING OUTCOME
TREATMENT A
TREATMENT B
LOW
HIGH
APTITUDE
Disordinal ATI
LEARNING OUTCOME
TREATMENT A
TREATMENT B
LOW
HIGH
APTITUDE
Ordinal ATI

Figure 1.

this regard. The development of new media and instructional technologies is rapidly expanding the variety of educational experiences with which to confront learners and is permitting individualization of many learning situations. Without detailed understanding of how particular instructional treatments relate to individual learner needs, the advertised value of individualized multi-media instruction is an empty promise. Individualization implies classification decisions in schools and these require disordinal interactions, so we must begin to search for these important phenomena. The concept of a single best method of instruction for everyone is like the search for the Holy Grail.

There is, however, a more pervasive aim for ATI research in behavioral science generally. The experimental psychology of learning and cognition has developed to the point where the primary theoretical activity, whether neo-associationistic or cognitive in orientation, concerns the understanding of internal mental events mediating between observed stimuli and overt responses. The use of aptitude variables to represent the psychological and biological history of the organism may be the best and in many cases the only way to gain access to these events. Differences in the probability of occurrence of some internal event may be represented for individuals by scores in another task or test where performance depends on that response's occurrence. The relation of this performance to criteria for different experimental conditions shows the extent to which that mediating capability is involved in the process being manipulated. Similarly, comprehensive understanding of the differential psychology of man will never be achieved by more and more detailed factor analytic description alone. Access to the internal processes determining performance on differential measures is best gained through systematic experimental manipulation of the parameters controlling the appearance of differential capabilities or tendencies.

Ultimately what is needed is a grand Darwinian matrix of

organisms by environments where both can be characterized by many dimensions and partitioned to show the particular types of treatments in which particular types of learners thrive. For any given hypothesis, the goal is to find the limits of generalization, that is, the subset of treatments and persons over which a generalization applies. Or, to put the issue again into educational outcome, find the combinations of treatments and persons that maximize obtained outcome. An adequate theory of instruction will never be attained without simultaneous consideration of both the situation dimensions and the person dimensions. These dimensions will need to be expressed in roughly comparable terms, which may bear little or no resemblance to descriptive dimensions currently in vogue.

With respect to media research then, a prime task is to define some initial stimulus and person dimensions. Their value can be assessed for ATI hypotheses and the foundation is then laid for the design of ATI research on media.

Person Dimensions Relevant to Media Research

If one surveys the field of differential psychology in search of constructs useful in ATI work, one is first staggered by the sheer number of different dimensions available and then stopped by the recognition that few if any of these dimensions have been sufficiently validated or interpreted in terms of psychological processes presumably represented by each. It is like walking through a supermarket where one is unsure which of the brightly displayed packages contain the advertised food, which hold cheap filler, and which are empty facades. Depending on one's purposes, of course, there are some guidelines. Some potential aptitudes have been involved in a great deal of prior research, and one can gain some idea of their meaning by reviewing that work. Most of this prior research, however, will not have been interactional in nature. On the contrary, many differential measures have been distilled through pilot research be retaining only those items predictive of a wide variety of

situations. Potentially interacting items have been dropped. Other measures have received construct validation in the sense of intercorrelation among like measures, but rarely have they been subjected to experimental manipulation of either test or criterion situation. Since we are interested in constructs offering some theoretical utility in ATI research, we must start almost from scratch--selecting, modifying, and constructing measures to fit our *new* needs. A review of what ATI research has been done on the supermarket's inventory will be worthwhile, since the nature of some existing differential dimensions may suggest important ATI hypotheses; but much research will have to be done before confidence can be attached to any particular construct or interpretation.

We may start by subdividing variables into a few major categories, though it should be noted that such clusterings are convenient fictions at best. Eventually, the most valuable constructs may cut across these artifical boundaries. The main groupings are intellectual abilities, personality traits and interests, and cognitive styles and preferences.

The nature and organization of human intellect has been the subject of much research in this century, particularly by those of factor analytic persuasion. There now appears to be two main systems of though about ability organization. Guilford's (12) structure of intellect model, which follows in the Thurstone tradition, posits at least 120 separate mental abilities organized in a three dimensional Cartesian system. The main distinctions deal with the kind of information to be processed (figural, symbolic, semantic, or behavioral), the mental operations applied (cognition, memory, divergent thinking, etc.), and the mental products to be obtained (units, classes, relations, etc.). As suggested elsewhere by Seibert and Snow (16) the number of factors might be enlarged still further if test media other than printed paper and pencil are considered. Guilford regards his abilities as distinct mental functions which may usefully

serve as components in task analyses of more complex intellectual activities but which cannot reasonably be subsumed under more general ability constructs. In contrast, Vernon (19) and Cattell (3), following the tradition of the British hierarchical model, suggest that Guilford abilities are relatively specific and combinable first to form minor group factors, then major group factors, and then still more basic general factors. Cattell in particular has theorized about the nature of two such general factors: fluid intelligence--representing abstract analytic and reasoning ability, and crystallized intelligence--representing complex and mathematical comprehension and other educational skills.

If the ATI research done so far using ability variables has any conclusion to offer, it is that fine distinctions between Guilford's abilities are probably not justifiable. There are only a few studies showing ATIs and these typically involve only the content or kind of information dimension of Guilford's model. Other distinctions have not shown interaction with instructional treatment variables, though admittedly little work has been done. One value that can be claimed for the model is its use in task analysis of instructional programs. It may offer some help in structuring our hypotheses about learning processes, even if the ability constructs suggested thereby are more global than Guilford's individual cells. In learning from audio-visual presentations, one might expect heavier reliance on abilities representing figural and behavioral content and alternative strategies for cognition and memory storage, relative to other forms of instructional presentation. To date, research on media has not examined these possibilities.

One clear conclusion is that some form of general ability, representing both fluid and crystallized components, is strongly related to learning in many instructional situations. It has also been shown strongly evident in programmed instruction, despite early claims that programming would reduce the effects of intellectual differences among

learners. Some studies show that ATI are obtained using general ability as the aptitude when an alternative treatment deviates from conventional written or spoken instruction but the pattern is not really clear.

It has been suggested recently (6) that the hierarchical conception of ability organization actually offers the most reasonable kind of system for the purpose of *using* ability variables in research or practice, regardless of whether human ability is *really* organized that way or not. For some purposes, one wishes a general construct. For others, quite specific distinctions may be needed. This position implies that ability constructs be judged in terms of their theoretical utility rather than their correctness. The hierarchical view is advocated especially for ATI work and is suggested as a useful organizing principle for other domains of individual difference variables and perhaps even for organizing treatment dimensions.

The personality and interest domain is perhaps the most difficult to deal with, yet ultimately personality variables may have the most pervasive effects on learning performance. Lists of trait labels abound, from the 5000 descriptor words of Allport and Odbert (1), through the MMPI and projective test scoring protocols, to myriads of commerically available multiscale measures and the ever-present interest inventories of Kuder and Strong. As with the ability domain, Cattell and Eysenck have suggested hierarchical organizations of personality. These seem less credible and less well substantiated with data than the ability system; but it is possible that similar use can be made of such organizations here, particularly within more restricted areas like anxiety and achievement motivation.

These two general concepts appear to be the best candidates for ATI hypothesizing currently inhand. Anxious persons have been shown to perform better in more structured situations, where error rates are low and feedback is clear.

Cronbach (5) has advanced an ATI hypothesis contrasting constructive vs. defensive motivation as related to structure, teacher control, and feedback conditions. This hypothesis deserves attention as a general organizing rubric for research in this domain. Also, it should be noted that there is increasing evidence for different kinds of anxiety arising from different classes of situations. As these differentiations become clearer, alternative treatments for ATI work with anxiety constructs may be suggested thereby.

Isolated findings have shown interactions using constructs like ascendancy, responsibility, and interest patterns described as technical interest and masculinity; but it is impossible to gauge the generality of these findings or to relate them to clear media variables.

The newest and perhaps most intriguing category of individual differences is a poorly defined group called "cognitive styles." Among the many variables listed here, two have received more systematic attention and appear relevant to media research. One is called "field independence" or sometimes "field articulation" or "differentiation" (20). It represents the extent to which a person can isolate stimulus details in a complex spatial array despite compelling background forces. It is usually measured by Hidden Figures or Embedded Figures tests and is known to be highly related to general fluid ability. The second is called "leveling-sharpening" (11). Across successive presentations, learners assimilate new stimuli to a dominant cognitive organization and tend not to distinguish further between new and old stimuli. Sharpeners, on the other hand, discriminate and separate successive stimuli and notice changes in the series.

This dimension may also relate to intellectual abilities, particularly in the memory domain. Both variables have shown correlation with several personality dimensions also. It is suggested here that these perceptual--cognitive styles may be particularly useful in investigating characteristics of

audio-visual communication. Each represents a different aspect of stimulus reception capabilities in the learner and thus may relate to variations in display characteristics particularly in visual presentations. These individual differences in perceptual styles may interact in important ways with some of the perceptual phenomena. These stylistic variables appear analogous to Fleming's spatial and temporal structuring characteristics of stimuli. (See pp. 119-136.)

Treatment Dimensions Relevant to Media Research

In contrast to the volume of work aimed at identifying personal dimensions, there have been few attempts to construct a coherent system of treatment dimensions. As noted earlier, if advances are to be made toward theory that integrates person and situation, then situations must be capable of being arrayed on continua that represent dimensions of stimulus variation and these dimensions must be describable in terms comparable in some sense to those used to describe person dimensions. It is unlikely that any generally satisfactory system can be achieved easily. Much theoretical and empirical work is required. It is possible, however, to make some rough suggestions toward that end, though presentation at this time must be quite sketchy and brief.

The concepts of hierarchical arrangement and referent generality have proved useful as organizing principles for thinking about individual differences, at least in some areas. One can examine a relatively specific spatial orientation ability, interpret it as a component of more general spatial ability, then subsume this with other measures to form abstract reasoning and finally recognize the combination as a manifestation of general intellectual ability. Similarly, this approach may be tried in attempting to define and organize treatment dimensions. Just as with mental abilities, hierarchical order is not proposed as the necessarily true or correct way to organize stimulus variables but only as a potentially useful way to think about such dimensions.

As one surveys the full array of instructional media and methods, there appear to be some general dimensions that are involved to some extent in all instructional situations. The general concepts of amount of information, redundancy, complexity, or difficulty displayed in treatments appear to be general constructs of this type.

Three other fairly general dimensions, though placed somewhat lower in the hierarchy, might be overall rate of information presentation, kind of information content, and general "grammaticalness" or coherence of a presentation. Perhaps the extent to which an instructional communication deviates from the conventions of its medium is part of this "grammaticalness" idea. Similarly, we can deal with stimulus dimensions still lower in the hierarchy. Such characteristics as the extent to which responses to be learned are explicitly modeled, the extent to which treatments are rationalized or made meaningful through explanation, overtness-activity vs. covertness-passivity of response requirements, the extent to which the presentation is made smoothly structured and linear for the learner vs. the degree of control the learner has over his own organizing activity, the inductive vs. deductive aspects of the presentation, and the style of reinforcement and feedback used.

At a still more specific level in the hierarchy, variables begin to represent unique features of media and methods rather than features held in common across different media and methods. Examples might be the kinds of prompting, fading or branching used, specific sequencing characteristics of a medium, frequencies of concrete nouns or action verbs, the mix of information channels in film or television, different cartoon or narration forms, the inclusion of attention directing cues, the number of cuts or changes in camera angle, etc.

There have been ATI studies conducted on some of these dimensions and the results have not been impressive, for

many reasons. But more penetrating theoretical analysis, particularly of the general dimensions, coupled with analysis of the individual difference dimensions involved and improved ATI methodology, should begin to pay off. Recent studies by Salomon in this direction are quite encouraging (15).

Heuristics for Devising ATI Hypotheses

With some ideas about person dimensions and treatment dimensions in hand, it is then possible to begin thinking about how such variables might combine to produce disordinal interactions. The best strategy will probably be to choose aptitude and treatment variables of interest, using whatever evidence or theory is now in hand about them, and to investigate their interaction through a series of iterative experiments. One investigator may be mainly interested in a particular treatment comparison, like some variation in TV production. He would then try to specify the kinds of learner skills or styles particularly important for each treatment. There is no substitute in this work for detailed task analysis of what is required of the learner in each situation. Some variants of the approach used by Gagne may serve here (9). Impressionistic ideas about likely modes of behavior in each treatment, perhaps obtained from introspections of learners in pilot trials, will also be useful. The selection or construction of aptitude measures for this particular contrast then follows. The key questions are What are the relevant strengths of learners who do well in one treatment as compared to those who do poorly? Among those who do poorly, are there strengths that are, or could be made, relevant in the other treatment? What would one need to do to either treatment to reduce its reliance on a particular learner strength or to avoid a particular learner weakness? On the other hand, another investigator may be primarily interested in a particular aptitude variable and thus start from the other end. Again, task analysis of the aptitude measure in question is indispensable. With such a presentation in hand, one can then ask: What kinds of

stimulus situations would magnify the relevance to learning of competence in this area? What would a treatment have to provide or circumvent in order that the "low" aptitude learner is not hampered by his weakness?

Given that the first work shows some interaction, successive studies would add, subtract, or otherwise modify aspects of the aptitude and treatment conceptions in line with the growing interpretation. Hoping eventually to maximize the interaction, modifications might include the elaboration of some explanation variable, the addition or dropping of attentional cues or pictures, a change in the pacing conditions, the sharpening of some measure to bring personality or attitudinal variance into combination with intellectual skills to help define an emerging stylistic variable, etc.

There appears to be at least two ways of thinking about ATI hypotheses, which sometimes lead to conflicting predictions. These two approaches to ATI are the preferential model and the compensatory model. We may hypothesize that some learners who are high in spatial ability would benefit from increasing the figural pictorial component of an instructional program so that the central ideas are conveyed by visual rather than verbal skills so we will reduce the pictorial treatment's reliance on words. A verbal treatment could then be constructed which played to the high verbal student's strengths. It would rely on verbal means to convey conceptual material and leave out pictorial representations, which are probably lost on verbal learners anyway. This hypothesis is the preferential model. The treatments are designed to capitalize on the apparent strengths and preferences of each kind of learner.

The compensatory model proceeds differently. Here we might argue that the treatments should compensate for each learner's deficiency by providing the mode of representation that the learner cannot provide for himself. The treatment then circumvents the weakness by short-circuiting, or

supplanting, in Salomon's terms. Since the highly visual type cannot provide the complex verbalization himself, the treatment should provide it for him, relating it to the pictorial representations he can generate himself. This treatment would then include only those figural cues needed to tie its verbal material to visualizations supplied by the learner. The highly capable verbal learner, on the other hand, would receive a treatment that supplied visualization to go with the verbal representations he himself could generate. Thus, each treatment serves as an externalized aptitude, or prosthetic device, which compensates for the weakness in a particular kind of learner.

Now note that, in this example at least, the two model ATI hypotheses appear to contradict one another. In Figure 2 (a), the preferential model suggests that the relation between spatial ability and performance will be positive in the visual treatment but zero or negative in the verbal treatment. The compensatory model in Figure 2 (b) predicts the opposite, that the relation between spatial ability and performance might be negative in the visual treatment but positive in the verbal treatment.

I have picked this practice example to show extreme alternatives using simple conceptions of aptitude and treatment variations. It may be helpful to use these two models in ATI hypothesizing, but it may also be that obtained ATIs will represent some combination of both models. If so, then some more complex form of compensatory-conciliatory process will need to be entertained. It should be noted also that the gross verbal-visual contrast exemplified here is probably not a valuable hypothesis. Studies by Carry (2), Hamilton (13), and Gagne and Gropper (10) suggest that finer delineation of treatment content variables and more exacting analysis of the cognitive skills involved in each is required. This particular global hypothesis appears untenable.

Now let us take up some real studies that should serve to

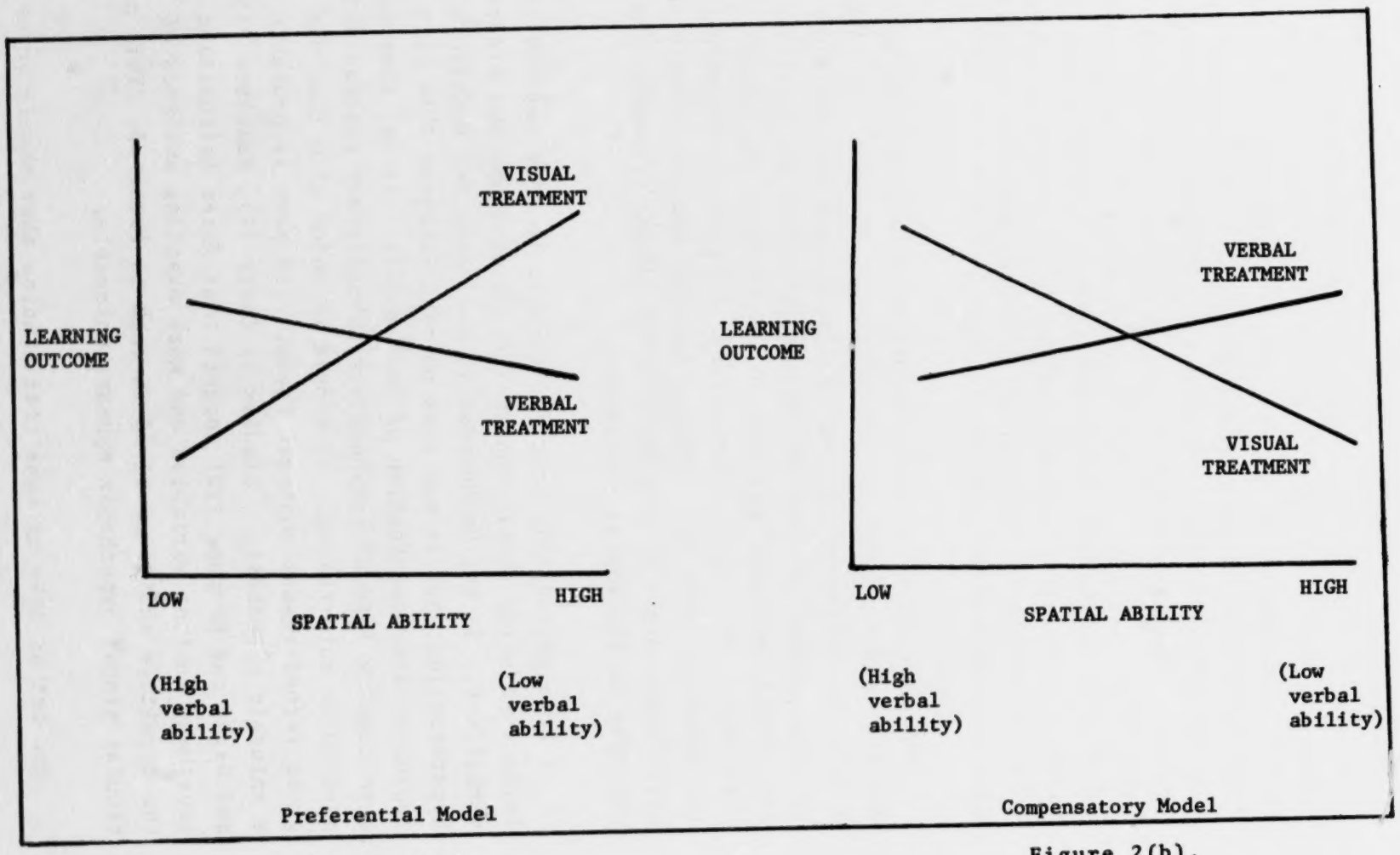

Figure 2(a).

Figure 2(b).

demonstrate the kind of hypothesizing represented by the models.

Salomon randomly divided 26 teachers in training between treatments designed to improve hypothesis generation (HG) or cue attendance (CA) skill (15). Both groups saw a film made by random reorganization of scenes from a coherent film. HG Ss were then asked to provide as many alternative explanations or hypotheses about the underlying story as they could. The film was replayed until Ss produced at least 12 hypotheses, CA Ss were asked to report as many stimulus details as possible. Trials were repeated until Ss had listed 150 visual details.

After training, a transfer test ("Information search") posed a complex problem involving the development and staffing of secondary school English departments in a Spanish-speaking district. Each S generated questions he would want to have resolved as he worked on the problem, his score being the number of questions listed. The aptitude variable of interest was general verbal reasoning (GRE-V).

HG training led to more question asking where GRE-V scores were 550 or better (Figure 3); Ss scoring below 550 produced more questions after CA training. CA apparently requires one to lift restrictions on attention, to report details without evaluating. Perhaps this bores the more verbal subjects. It may be best for less able Ss precisely because it promotes attention to detail. HG training may require more verbal analytical and reasoning skill and thus may be more challenging and preferable to high-ability Ss. In other terms, HG and CA approaches may represent alternative problem-solving strategies, each useful to different pupils. Such findings might also result if skill in CA is prerequisite to HG performance, and both are dependent on general ver-verbal facility.

Koran, following earlier work by McDonald, designed

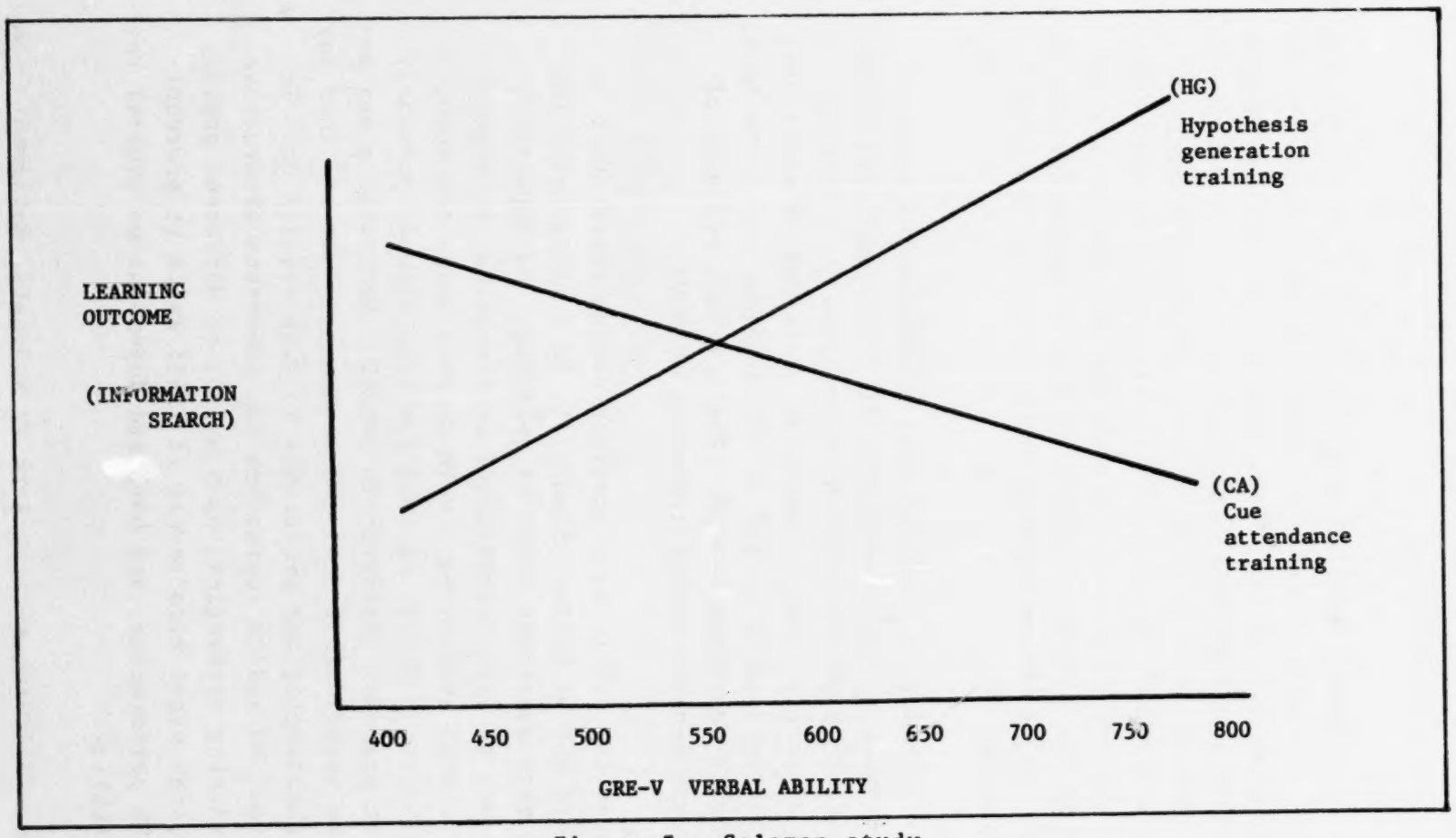

Figure 3. Salomon study.

alternative treatments involving various kinds of models to improve intern teachers' ability to ask analytic questions in microteaching situations (14). Microteaching is a laboratory arrangement in which the trainee teaches a prepared lesson to a few pupils for ten minutes. The trainee receives feedback or criticism and replans his lesson, then returns for a further teaching trial with other pupils. Teacher interns (N=121) were randomly divided to form three groups. In a video-modeling treatment (VM), S viewed videotape of a master teacher performing the required skill between microteaching trials. In the written-modeling treatment (WM), S studied a typed transcript of the sound track for each trial. In the control treatment (NM), S received no information between trials. The number and nature of analytic questions served as criteria. Pretest aptitude measures were perceptual and verbal factors from the ETS Kit (8) and from earlier work (17).

The relation of criterion performance to Part 1 of the Hidden Figures Test is traced in Figure 4. Parts (a), (b), and (c) show separate regressions of the criterion on aptitude for the three teaching trials, respectively. The WM treatment worked best for those scoring high on Hidden Figures, Part 1, while VM was best for low scorers. As noted earlier, Hidden Figures performance can be interpreted as an index of general ability or of Witkin's field independence. The verbal, self-paced, unrestrictive, articulate treatment, WM, made this aptitude of positive value. In VM, the audio-visual, fixed-pace, attention-restricting treatment, "low aptitude" Ss did best.

Part 2 of the Hidden Figures did not show interaction, but it should be noted that two parts of speeded unusual tests may well tap different aspects of learning ability. In addition to the Hidden Figures results, some similar interactions were obtained using Maze Tracing Speed, another perceptual test. Also of note were interactions obtained with an experimental film memory test, to be described below.

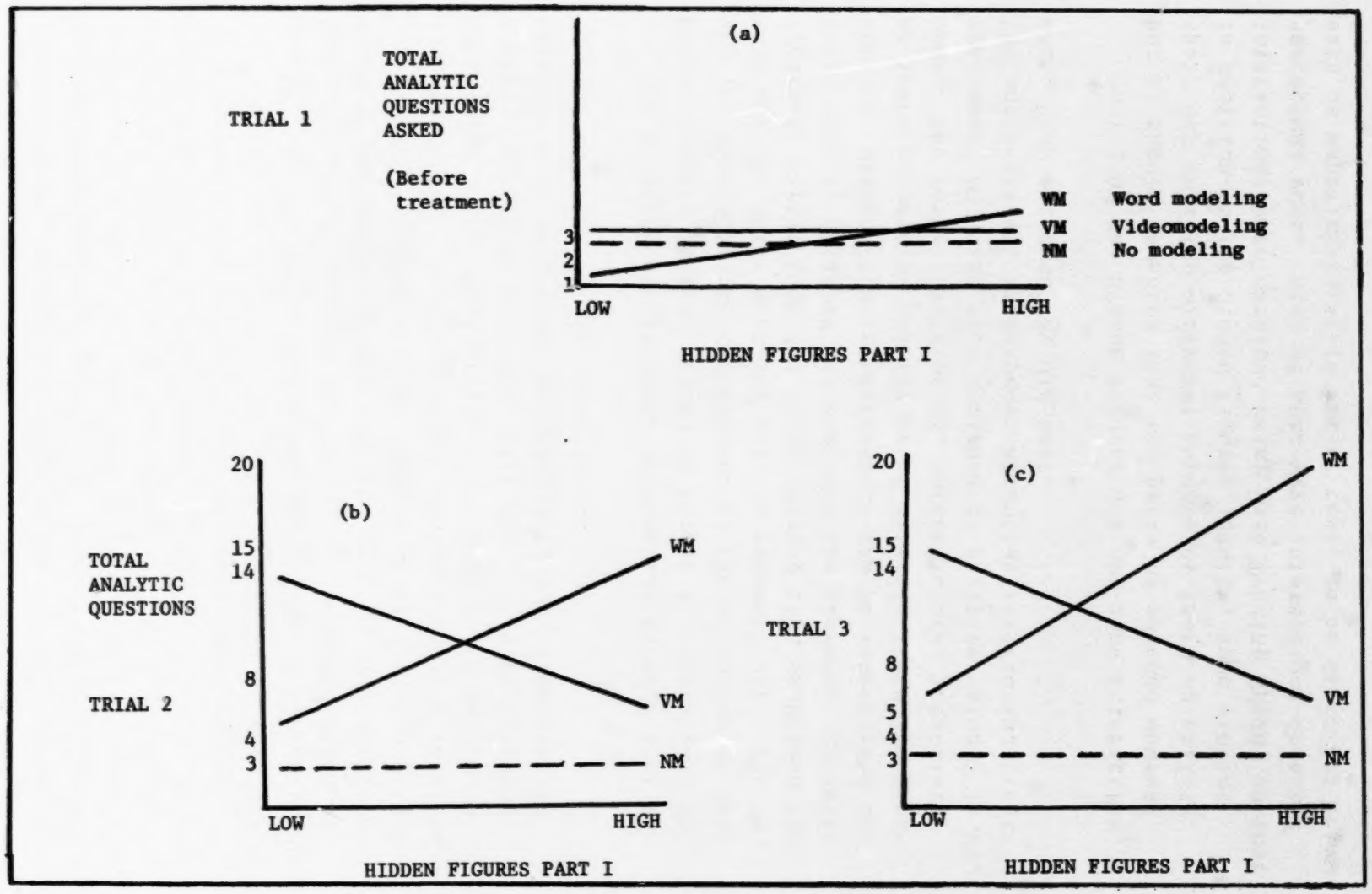

Figure 4. Koran study: simple regression analysis.

No ATI were obtained using tests representing perceptual speed, verbal comprehension, auditory memory, or expressional fluency.

Let us here attempt to interpret the Salomon and Koran work together, along with some other implications. The emphasis of the CA and VM treatments appears to be attention to and differentiation of stimulus detail. In HG and WM treatments, these processes presumably are necessary but are not explicitly forced. These treatments allow more associative inferential behavior. Now suppose that the aptitude variables used in these studies are taken as aspects of general ability. Perhaps lower-ability Ss are weak primarily in attentional and discrimination skills, as suggested by Zeaman and House (21). This would account for weakness in CA and VM treatment. Perhaps such Ss are deficient also in employing certain kinds of symbolic coding during conventional instructional tasks. CA and VM treatments compensate for this lack by detailed drill that isolates stimulus elements and employs concrete representations. These treatments may provide coding systems for the learner thus improving the performance of low-ability Ss. High-ability Ss do badly on these treatments, perhaps because they react negatively to emphasis on detail. High ability pays off in HG and WM, where these Ss can mediate, abstract, and reason at their own relatively fast pace. The emphasis in these treatments is on the rapid manipulation of symbolic meaning, probably a preferred mode of operation for high-ability Ss but one unsuited to low-ability Ss. These latter treatments are more similar to conventional meaningful instruction where outcomes typically relate positively to general ability.

Thus, it does seem that interaction arises in these studies from a compensatory-conciliatory process in which some harmony between the defects or style of the learner and the characteristics of the treatment is achieved. For the low-ability S, the good treatment provides aid in stimulus differentiation where he is deficient and needs compensation.

For the high-ability S, the good treatment provides the associational latitude which he prefers.

If this hypothesis has validity, it should be possible to take some further steps toward expanding the current conception of aptitude. Those who do best under CA and VM treatments should be describable in positive terms, not merely as persons of low general ability. We should be able to construct new aptitude measures, which tap skill in stimulus differentiation and in the use of coding systems not typically found in conventional instruction. Some attempts at such development have resulted in a number of experimental tests using motion pictures as the communication medium (16, 17). One such measure, called Film Memory, was involved in the Koran study. In this test, S attempts to recall the content of a live-action silent film. The content portrays complex human behavior, largely nonverbal, that is probably hard to encode in symbolic or verbal terms. Combining this test with Hidden Figures, Part 1, in multiple regression analysis, Figure 5 was obtained. The criterion here is the number of analytic questions asked by teacher trainees on trial T_3 of the three-trial microteaching treatment. (The control group is not shown.)

The planes for the two modeling treatments are differently pitched. Film Memory functions in a manner opposite to that of ability measures considered earlier; the regression slope is *positive* for VM and *negative* for WM. The two planes intersect to form a line, which has been projected onto the base plane to show how a two-dimensional decision rule would be used to classify Ss on the basis of the bivariate aptitude. Ss high on Hidden Figures, Part 1, and low on Film Memory should be given the written modeling treatment. Those with good Film Memory, especially if poor on Hidden Figures, Part 1, would be better off in the video-modeling treatment. The earlier discussion of preferential and compensatory processes applied here. One can interpret positive slope as indicating that a treatment capitalizes on

an ability, while negative slope suggests that a treatment compensates for low ability and frustrates high ability.

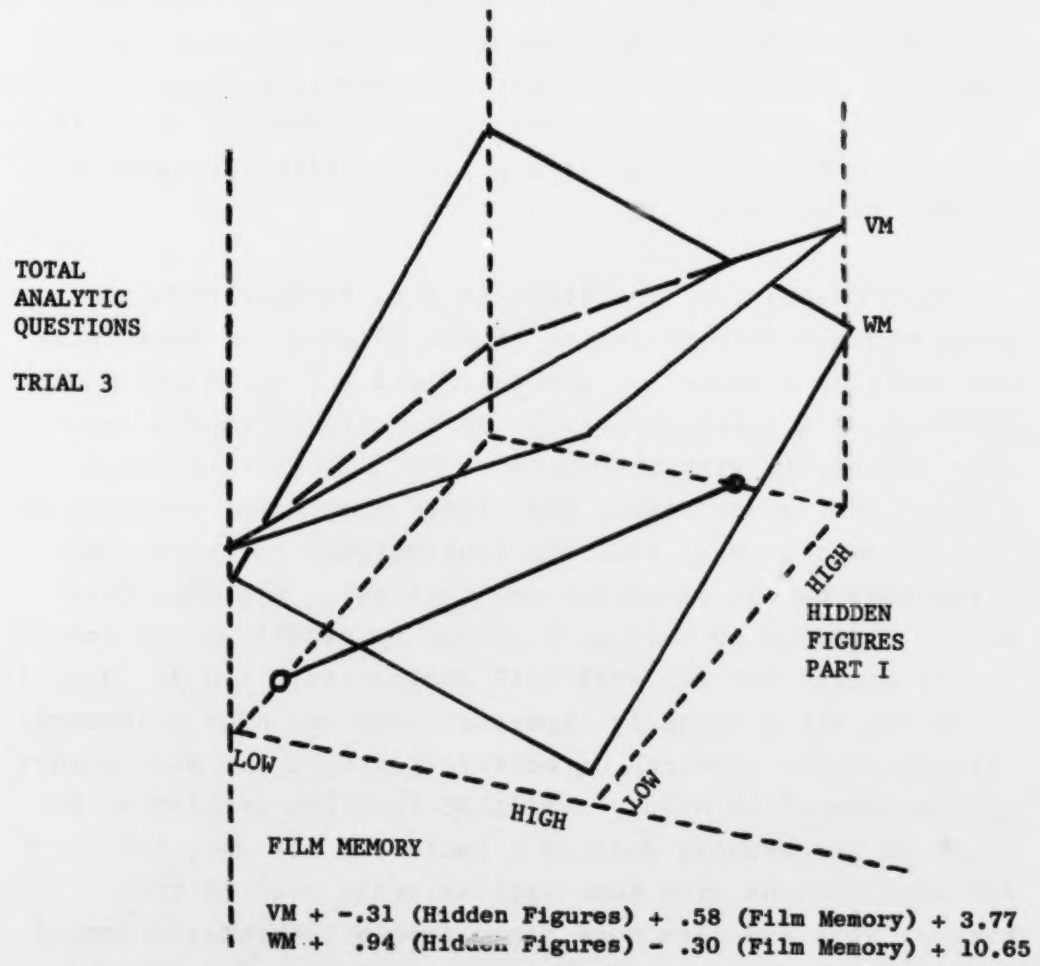

Figure 5. Koran study: multiple regression analysis

Figure 5 suggests that multiple combinations of specially constructed aptitude measures may be necessary to reach large ATIs that generate considerable achievement payoff. The kinds of aptitude defined in the base plane of Figure 5 represent a significant departure from traditional conceptions. Film Memory is not an ordinary experience in test taking, even for college students; and Hidden Figures, Part 1, is just the first half, perhaps the learning-trial half, of a conventional test.

The preceding discussion leads toward a general

conception of instructional treatments as prosthetic devices for particular aptitude groups. A treatment that proves especially appropriate for a person deficient in some particular aptitude may be functioning as an "artificial" aptitude. It contains the information processing functions that the learner cannot provide for himself. Whether there is value in this conception as a guide for identifying ATIs remains to be seen.

This discussion also leads to some further thoughts about media. Interpretation of the Salomon and Koran studies rests on a choice of general fluid ability-field independence as a first aptitude. This variable should correlate positively with instruction that allows self-paced, rapid scanning and review and allows meaningful association and inference. Many familiar conventional instructional situations can be characterized this way. Why does Film Memory function so well as a second aptitude? Is it particularly useful for ATI work with audio-visual media? Does its value suggest a uniquely important role for cine-psychometric devices in ATI research on media? There is not much information about Film Memory available from the earlier work since it has usually defined a factor of its own, but there are implications from some similar tests used in the earlier work and also some hints from a theoretical consideration of the nature of the task involved. Film Memory performance may represent the ability to distinguish and remember both central and incidental visual details in complex ongoing visual presentations. The individual who performs well here may use a different form of image representation, storage, and retrieval system from individuals who perform poorly. This process, in turn, hints at three other ideas about human learning and development. One, suggested by Deese (1964), is that incidental learning is different from intentional learning only in the coding or representation system used. Thus, the incidental process may rely on a less efficient but more exacting internal record of the stimulus situation. Note here also, Fleming's review of

Bower's work. Secondly, this matches Bruner's notion of iconic representation system which forms a stage in early human development but which remains for use throughout life as a kind of more primitive and subordinate, but sometimes more useful, learning system. The third idea is that a perceptual cognitive-style like leveling-sharpening may represent the same distinctions between representation systems. The leveler conceptualizes, integrates, and accumulates a dominant cognitive organization. Perhaps he uses abstracting codes (i.e., modifies new stimuli to fit a growing symbolic system). The sharpener discriminates and maintains a perceptually distinct set of stimulus images, perhaps a more iconic representation. This is essentially speculation but it is consistent, if loosely, with a rough organization of much theory and research now in hand on learning, development, and the effects of some kinds of audio-visual experiences. If it is borne out by further work, however, it represents the first example of a new definition of aptitude of particular relevance to research on audio-visual media. The conventional concept of general intelligence or aptitude was the Victorian Englishman's way of understanding differences in learning from his kind of instruction. With new forms of instruction, it stands to reason that there should be new conceptions of aptitude.

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The development of self-instructional, self-testing, easily-understood materials of instruction can be revolutionary. They can break the grip which inflexible requirements of time and place of instruction now hold on schools and colleges. Our present focus of attention is often on the teaching and not on the learner. There can be learning without teaching and teaching without learning. If students learn well, they have been taught well--no matter who taught them or what instructional materials were used.

---Edgar Dale, Editor
The News Letter
March, 1970

Our Declaration of Independence tells us that life, liberty, and the pursuit of happiness are our inalienable rights. However, without the right to education, all other rights are diminished. The right to education is as vital in today's society as that of freedom of speech. What value are the freedoms to speak or to petition or of the press if one cannot articulate a grievance, proffer an appropriate solution, or even read? Who can calculate the loss to the nation--indeed to the society of man--of an undeveloped latent talent? Have we lost a cure for cancer, a new brilliant social philosophy, an inspiring symphonic composition because an infant was malnourished, because a child never learned to read, or because the tuition for college could not be paid?

The ideal for a democratic society must be the fulfillment of the capabilities of all individuals. Educational opportunity is a fundamental means to that end.

---*Hubert H. Humphrey, guest editorialist in The School Administrator, May, 1970*

THE MOTION PICTURE AS A PSYCHOLOGICAL TESTING MEDIUM: A LOOK AT CINE-PSYCHOMETRICS

warren f. seibert

FOR REASONS that should be clearer later, the inclusion in the present context of a report concerning the psychometric uses of motion pictures is based more on the novelty and the unexploited promise of such work than on the quantity or firmness of evidence thus far produced. This is not to say that data are absent; they are only in short supply. And although this is essentially true, the opposite might have been true, since some recognition of the film's psychometric potential dates back two generations, touching even the earliest days of modern work on human abilities. In other words, it pre-dates World War I.

Even though film's psychometric potential is old and recognized and even though several of the most honored psychologists are among those found in the accumulated literature--names like Boring (3), Guilford (10:414; 11:396), Gibson (9), and Thurstone (16:404)--there still is no sustained effort or momentum in the field. Currently, a quarter of a century after one major project and a half-century after the field's

inception, research is dormant again. That fact and some earlier experience in describing cine-psychometric work to other audiences suggest that this report should proceed as if psychometric films were a new idea; audiences still too readily associate film with entertainment or, to a lesser extent, with instruction; and they associate ability testing with paper-pencil techniques. They seem not to accept easily statements that violate these associations. Nevertheless, we can with profit regard film as a versatile, generally reliable audio and visual communications medium; and we can regard psychological testing simply as communication which has rather specialized purposes.

Once the prevalent and artificial separations of films, tests, and communications are overcome, it can become easy to generate research questions which are finally within reach, to imagine applications of such tests in educational assessment, talent identification, and otherwise. It may seem that most earlier research on the nature and dimensions of human ability has been unjustifiably narrow in its conception and procedures, since "Many human decisions are made within contexts which are not static, not principally verbal, and not characterized by the presence of print" (14:140). If one suspects, as do Ferguson (6, 7) and others, that culture exerts a major influence on the nature of the developed human abilities, then there is likelihood also that these "many human decisions" leave their mark on the intellect of the culture's members. Much of this is speculation, of course, but that does not make it necessarily weaker than the opposite assumptions which extend implicitly through the literature on intelligence and ability. Speculative as it is, we may entertain the notion that human abilities are not only various and shaped by the requirements which culture imposes, but also that they include components which are not amenable to the prevailing and conventional forms of testing.

The suspicion that conventional forms of testing are too restricted was a major factor in the decision during World

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War II to establish the Air Corps' Psychological Test Film Unit. This unit, under the direction of Dr. J. J. Gibson (9), developed more than 20 motion picture tests, virtually all designed for use in the selection of military aircrewmen. It seemed then, and is reasonable still, that the task of air crew members puts a premium on several rather specialized perceptual abilities, especially visual perceptual abilities. Air crew members are required to operate in a moving, three-dimensional visual environment and to judge distances, motion, positions, and rates of motion or change. Ability to make these judgments is rarely evaluated directly by conventional ability measures, and it was therefore plausible that their measurement could contribute to improved selection of air crew trainees. In the almost two years of the unit's existence, it planned, produced, and refined the nearly two dozen novel tests; but material shortages and then the decline in the training requirements and tempo of the war resulted in the limitation of contemplated validity studies. It still is unknown whether the tests' original purposes were met. The few validity estimates that were obtained gave too little indication of worth to allow such judgments; however, the work established the feasibility of such tests and the prints which still remain demonstrate well the new forms and tasks which film makes possible.

The work of Gibson and his co-workers can be regarded as the earliest of "modern" film testing, since for the first time film was extensively used as more than a container or record of normally-occurring events. The earlier applications of films had tended toward these simpler recording uses, as evidenced in the work of Boas (2), Boring (3), Metfessel and Warren (12), and Carmichael, Roberts, and Wessell (4). But Gibson, while not totally avoiding the events-recording or "window-on-the-world" functions of film, made extensive use of animation, editing techniques, and mock or simulated conditions to achieve test purposes. Among his test films are examples simulating approaches to an airport runway and requiring judgment of the likely point of landing; others requiring judgment of an object's velocity or change in velocity; and still others requiring integration or discrimination of simple, momentary cues in a complex visual field. These are but a few of the tasks prepared a quarter century ago; and they are described here only as they appear, not necessarily as they may function psychologically.

The history that is barely sketched here and that is more thoroughly treated in an earlier article already cited (14) gives many justifications for the study and use of psychometric films. This history reveals not only the names of illustrious contributors but also a field for psychological research that is promising, novel, and largely untouched. It offers, first, greatly expanded opportunities to examine hypotheses that derive from views like those of Ferguson (6, 7), views which assign major importance to cultural demands as shapers of intellect. Second, with film the chances for studying a great variety of abilities, especially memory abilities, are immediately available. More will be said about this later, so suffice it to say here that the very short-term memories, which conceivably encompass the most significant events-phenomena from all of psychology, can be efficiently and systematically examined. Also, since the presentation or exposure of item materials can be precisely

sequenced and controlled, film tests allow expanded and more detailed response recording: GSRs during problem-solving, electroencephalographic recording, and visual scanning records, as well as all conventional forms of response and record. It is hard, for example, not to be interested in examining the EEG patterns or the visual scanning behaviors of Ss who are presented with systematically varied and/or factorially distinctive test items.

On the more practical side, there are other motivations. Film can be used to assume the main tasks of the test administrator and to perform these reliably on each occasion. It can more nearly simulate many real decision situations, as in trouble-shooting or the analysis of information from a real and complex perceptual field. It can present information in large or small amounts without necessarily using language; the significance of this in the testing of special populations--the educationally deprived, the auditorially handicapped, the young--is not hard to imagine.

A difficulty for most researchers, but especially for those who choose large and uncharted regions to study, is deciding what portion of the domain to examine. For Gibson this question was largely answered by wartime manpower requirements. He needed to focus on the development and study of perceptual ability measures which seemed related to air crew tasks, but unrelated to other successful measures already used for air crew selection. In one very limited sense it would be good if a similar, clear need could be found to guide contemporary work, but none has; and the work, when it is not altogether dormant, seems somewhat schizophrenic. Our own work has attempted to make both early and practical contributions and to ask more basic questions. There was need still to demonstrate the feasibility, or perhaps it was the ease, of developing and employing novel test types. This need surely is accomplished now. There was and is the desire to devise measures useful in educational and in other applied settings, especially

those which might assess ability to learn in non-conventional (e.g., audio-visually mediated) instructional settings. Then, more basically, there are the broad, strong, and related suspicions that intellectual abilities can develop in response to cultural requirements and also that static print is too restricted to elicit the full variety of abilities.

Recent research, like Gibson's work a quarter century ago, is forced to rely heavily on ideas and experimental tests specially developed for the purpose. In all, about fifty such tests have been developed during two research projects (15, 13) and these tests represent not only many purposes, hopes, and formats, but also a wide range of technical quality. Some were never developed past the point of being a few filmed items which are unedited, unrefined, and so far as anyone can yet tell, uninteresting. Others have been extensively planned, edited, and refined through multiple uses. They not only make good appearances, but also administer well and yield satisfactorily reliable scores.

Difficult as it is to describe the more novel and, we always hope, the more promising tests, some descriptions seem needed. As introduction, one should recognize that even though it is possible to develop "unitized" film tests (our term for tests which base several questions or queries on a single, continuous stimulus), most of the tests produced thus far have been "itemized." In these, a single question is posed and a single response required for each item stimulus. For a typical item, an item number will first appear for perhaps two seconds, the stimulus and its implicit or explicit query will be presented, and then a few seconds (i.e., 8-12, usually) are provided for Ss' decision making and response recording.

Several short-term visual memory tests have been developed, each of which borrows liberally from the experimental procedures of Averbach and Coriell (1). In the items of one of these, for example, an 8-letter (4 x 2) array is flashed

on the screen for the duration of one film frame, which is about 31 milliseconds (msecs). Then, at an interval which may precede the array by 52 msecs or follow it by 10, 94, 177, 260, 344, 427, or 510 msecs, a bar marker is flashed on the screen to designate one of the eight array positions. The Ss are then required to record the letter which occupied the designated array position. They are in effect required to hold the array in memory for intervals up to one-half second before they are told which element to record. As can be seen, eight subtests are derivable from this test--one for each memory duration--and, as it happens, each subtest includes eight items. Hence, there are 64 items and the total testing time is approximately 18 minutes. Two variations on this same test use, in the items of one, a circle or encircling marker, rather than the bar marker; and, in the other, a bar marker presented simultaneously with the eight-letter array and an encircling marker at the planned intervals after or before the array.

Short-term memory tests based on multiple-element arrays have been particularly interesting to develop and study. They include not only the three tests (and 24 subtests) just described, but also others based on 8-letter arrays that require recording (a) of each *full* array, (b) of only the *vowels* from each array, or (c) of letters *common* to two flashed arrays. Two other memory tests employ six color patches or samples in each item. These appear in a 3 x 2 array for 177 msecs, 344 msecs, or 510 msecs. There is then a 60 msec delay, which is followed in the items of one test by a hexagonal position marker and, in the other, by a colored horizontal bar which designates a color to be remembered. The Ss' task in the first of these is to select the color name which coincides with the designated array position. In the second, they must indicate the array position which coincides with the indicated color. These same two test formats are also used in two "object memory" tests. For object memory, photographs of common objects (a car, a shoe, a camera, a chair) are used in place of colored patches or samples.

The tests briefly described above are among the more attractive developed thus far and no small part of this attractiveness derives from the unusual, "Fleishman-esque" analyses (8) to which they are so amenable. Those who know Edwin Fleishman's work are usually intrigued by his productive combination of correlational and experimental methods. His method, in outline, is to administer multiple motor and intellectual ability tests, to give Ss multiple (and scored) trials for the learning of some motor skill, and then to factor analyze the several ability and skill-learning scores. His data repeatedly show changes in the factor composition of successive stages in skill learning. Our short-term memory tests, since they are systematically divisible into subtests, are equally suited to such analysis. In these analyses, the varied memory intervals or stimulus exposure durations are used in lieu of Fleishman's practice (or learning) stages (see, e.g., 15:83; 13:40).

These analyses of short-term memory abilities have produced some unusual results, much as the similar analyses did for their originator, Fleishman. A principal feature of the results also relates to some tests and to an ability factor which must now be identified. First, as brief background, in early work we borrowed a test title from Gibson and invented a task to go with it. The title was "successive perception," which for Gibson applies to two faintly similar tests. In one, each item requires Ss to identify a two-dimensional geometrical figure which is cumulatively revealed behind a downward-moving viewing slit. The entire figure is never seen, but over time, all parts are revealed. In the second test, a dot moves on the screen and describes a pattern, but leaves no trace as it moves. The task is to remember the trace, path, or pattern and to select it from among five alternatives.

Our versions of the Gibson idea, which we entitle Successive Perception III and IV, use a photograph of a common object within each item. The object is filmed while

successively concealed behind eight white mats or masks. In each mask square openings allow portions of the photograph to be seen and, across the full set of eight masks, all portions are revealed. In one version, Successive Perception III, the mask changes with each film frame, thus revealing all portions of the photograph three times per second. In the other, the mask changes every 625 msecs. Thus, all parts of the photograph may not be seen for almost 4.5 seconds. Not only does the slower change rate alter the appearance of the items, making the square openings seem to dance, but it seems also to increase the task difficulty by a large factor; mean scores on the first version have been in the range of 9.0-10.5 (of 20) and have been 4.0-5.5 for the second version.

In the few factor analyses completed thus far, our successive perception tests have shown a consistent affinity for each other and have been the principal, but not the exclusive, tests in a consistently appearing ability factor which has been named serial integration (or temporal closure); yet they show no affinity for Gibson's similar measures. The factor which they represent seems to be the ability to "bridge" small gaps in time and to merge intellectually the time-segmented fragments. Another of the tests appearing consistently in this same factor and one which adds credence to the above interpretation is entitled Sequential Words; its items present six-letter adjectives, one letter at a time, during an interval of roughly .5 second, and with each letter appearing in the same center-screen location. Examinees are required to recognize and record each word. As with our two Successive Perception tests, the ability to close or to integrate across gaps in time seems the most prominent feature in performance on Sequential Words.

The consistency of the serial integration factor is remarkable and impressive. Not only does it appear in each of our analyses where we could expect it (15, 13), but its composition continues to support the interpretations originally given to it. It also represents the best available evidence

that human abilities are more numerous and more varied than we normally think and that printed, static tests do not elicit sufficient variety. Furthermore, as suggested earlier, serial integration ability has given repeated evidence of involvement in certain subtests from two short-term visual memory measures. These measures, STVM II and III, have revealed and replicated a result which is essentially the following: during very short (i.e., 10 or 94 msec) memory intervals, serial integration ability is prominently involved and may account for as much as 20 percent of the variance; it subsides and is not involved noticeably with the intermediate intervals, but appears again and more weakly at the one-third, four-tenths, and/or one-half second memory intervals. In other words, these two STVM measures, which have in common a simple 4 x 2 stimulus array and an encircling marker to designate one element from each array, also show distinct and apparently reliable patterns of correlation with the serial integration factor. In these tests, when memory is required to operate across very short intervals, serial integration is most prominent; it is least prominent (or essentailly absent) across the intermediate memory intervals and is detectable again across the "longer" (e.g., .4 sec) memory intervals.

The significance of these sparse results, of course, can not be specified yet; but some of the more striking features bear emphasis and thought. First, the serial integration factor is a "first"; it is a talent or a fragment of human ability which is generally unexpected and unlike others that abilities psychologists have studied. It is also a dutiful and responsible ability, since it has always appeared whenever its conditions were met. In a sense, it is a brazen ability, not content simply to appear in factor analytic results and otherwise to remain invisible and aloof, but intruding itself into the STVM performances clearly and yet selectively. Because of this selective intrusion, there is now not only a mystery to pursue, but also a buttressing demonstration of the uses of Fleishman-esque analyses, and

the alarming realization that even though the STVM task was altered in the most trivial way (i.e., memory intervals were made longer or shorter, but always within a range of one-half second), it was still accompanied by detectable changes in what seem to be the underlying intellectual processes. A few milliseconds now seem more important than we customarily think.

In conclusion, Ferguson has suggested several points at which the interests of correlational and experimental psychologist overlap; centrally, the two groups share a concern with "ability." Also, Cronbach (5) has traced the separate courses of experimental and correlational psychology and has shown how reasonable it would be for them to merge and to develop supportively. Fleishman has demonstrated his agreement through a novel joining of procedures and concerns which are partially correlational and partially experimental. Limited though the cine-psychometric research has been, it, nevertheless, seems productive and seems most promising in a framework like that which Ferguson, Cronbach, and Fleishman reflect.

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MEDIA, EXPRESSION, and the ARTS

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THIS PAPER DESCRIBES the relationship between media, expression, and the arts and suggests what these relationships imply for educational practice and media research. To do this requires brief excursions into the meaning of expression, into the components with which the artist works, and into the demands visual works make on those who wish to encounter them on the plane of meaning.

The content of this paper rests upon seven ideas:

1. Expression is a consequence of intelligence.

2. The arts are one of man's major expressive modalities, hence depend on intelligence.

3. Expression proceeds through the forms of art by virtue of the symbols, syntaxes, and media with which the artist works.

4. The expressiveness of the arts is known by the experience the forms of art evoke.

5. To experience art forms requires an ability to "read" the form, that is, to decode what artists have encoded.

6. Artistic development depends not only on the artist's ability to create new symbols and syntaxes but also on the nature of the media available.

7. New forms of art evoke new forms of experience, inform us about the qualitative aspects of life, and reawaken our awareness to the old.

To assert that expression is a consequence of intelligence is not a self-evident truth. There are many situations in which the term expression is used to describe states of affairs that appear unrelated to intelligent action. An example would be facial expressions. We frequently describe certain postures or demeanors as expressive; we often express anger or joyfulness during certain events that touch our lives. The display of these conditions is not usually thought of as dependent upon the exercise of intelligence, and we seldom talk about them as acts of intelligence. If it is possible to describe expression as unrelated to intelligence, why should it be asserted that expression is a consequence of intelligence?

Expression demands more than self-disclosure. Expression requires a transformation of idea, image, or feeling into a medium that will give it public form. To behave impulsively, to display certain actions or attitudes is not to engage in expressive actions, for to conceive of such activities as expressive would require a conception of expression that included all of man's activities. Sleeping, snoring, the style of one's gait would in such a conception all be expressive acts. Such a concept would obfuscate the distinctly intelligent character of expressive action, not only in the arts but also in all other spheres of human activity where action depends upon deliberation. The distinctive feature of those who express themselves is their ability to relate matter in ways that reveal the qualities they have

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seen, felt, or conceptualized. The material that they employ properly functions as a medium, a vehicle, for carrying their ideas, images, or feelings forward. The material *as medium,* comes to embody these ideas, images, and feelings only after the artist has exercised intelligent control over the material. Material lacking intelligent action never becomes a medium. For material to become a medium, appropriate transformation must take place. Such transformation requires intelligent decision-making in the selection of the material to begin with, as well as during the process of creation. To express oneself, then, as Ryle (5) might say, is an achievement verb, not a task verb; to express oneself is to attain a state of affairs through deliberative, if not always through deliberate action.*

That expression is a dominant concern of artists and that works of art express something is almost a truism.

**Deliberative action* is action undertaken with purpose and serious intent. It seeks to achieve something of consequence but not necessarily something which is defined or conceived in advance. *Deliberate action* is action undertaken to achieve a pre-specified purpose. It is goal-directed in a highly particular way. Thus, Aristotle's observation that "Art loves chance" allows in the deliberative context opportunities for the emergence of forms that were not specified deliberately.

What is infrequently recognized is the role intelligence performs in achieving expression. For too long the arts have been viewed in educational circles and by the general public as a consequence of the unfettered discharge of emotion. To "express" oneself in art was to let oneself go, to give vent to feeling, to have catharsis. While this experience may include a satisfaction of artistic achievement, these achievements are not the result of emotional discharge. Artists like scientists must work long and hard to gain the type of disciplined control that art demands. The intelligence that is exercised in art, though often overlooked, can be cultivated through experience. That the forms of art are the result of that cultivation and are based upon intelligence has been argued cogently by Dewey:

> Any idea that ignores the necessary role of intelligence in production of works of art is based upon identification of thinking with use of one special kind of material, verbal signs and words. To think effectively in terms of relations of qualities is as severe a demand upon thought as to think in terms of symbols, verbal and mathematical. Indeed, since words are easily manipulated in mechanical ways, the production of a work of genuine art probably demands more intelligence than does most of the so-called thinking that goes on among those who pride themselves as being 'intellectuals.' (2)

The recognition that the arts are expressive and that expression demands intelligence does not by itself reveal how expressiveness becomes a pervasive characteristic of artistic form. An examination of the tools and tasks of the visual artist enlarges the concept of expressiveness. The task of the visual artist is one of transforming ideas, images, and feelings into an organization of qualities. "Quality" means the direct apprehension of sensory experience. Red, blue, light, dark, bright, dull are examples of qualities that the artist uses as vehicles and through which his ideas, images, and feelings are transformed into visual forms or encoded. These qualities are used as vehicles for the construction of morphemes, literally forms that are put together in composition. Morphemes are constructed and are

subsequently composed. They function as symbols of the artist's experience; they are the forms that convey or evoke the experience that is called art.

The forms of artistic symbols may be classified into four types: the conventional symbol, the representational symbol, the connotative symbol, and the qualitative symbol.

The conventional symbol is an arbitrary form that stands for certain events or ideas that are known by individuals in a particular culture. The Star of David, the Swastika, and the Valentine's Day heart are examples of conventional symbols that point to certain events or ideas that are a part of the currency of a culture. These symbols are imbued with meaning no different from those assigned to discursive terms. They are arbitrary forms that have been conventionalized by cultural patterns and as such are capable of being employed in artistic acts for the expressive ends the artist seeks to attain. The work of Picasso, Chagall, Levine, and especially Westermann and Kienholtz often utilize such devices for artistic purposes.

Representational symbols are forms which are designed to represent, almost literally, the empirical aspects of reality. Paintings which, for example, depict in literal detail the features of empirical objects are described as examples of representational painting or of realism as a style of art. Although it is clear that no work of art can be an exact imitation of a work of nature, it is also clear that some artists use forms which imitate closely the objects that are the subject matter of their art. The works of Wyeth, Homer, Bohrod, and Hopper are examples of works in which representational symbols play a prominent role.

A third type of symbol used in the visual arts, the connotative symbol, is the result of the morphological distortion of representational symbols and is used to convey a particular quality of expression, a quality which often can

not be conveyed in any other symbolic form. Connotative symbols are those symbols which alter the form of empirical objects for the sake of creating particular qualities of expression. The treatment of the human figure in prints by Munch, the exaggeration of animals in Guernica by Picasso, and the elongation of men in sculpture by Giocometti are examples of connotative symbols used in painting and sculpture. These symbolic forms--the elongated men of Giocometti, for example, take on peculiar expressive characteristics not only because the form as form is long, slender, and open, but also because the form is recognizable as man. The effect of the work is a function of the interaction of the form of art and what we perceive as non-art contexts. One might say that the most thoroughly imitative reproduction of an object, the most lifelike representation has the least degree of connotative quality, while the forms of art which deviate most from the objects from which they are derived have the greatest degree of connotative quality.

The fourth symbolic form the artist employs is the qualitative symbol. The qualitative symbol is an organization of qualities designed to represent some idea, image, or feeling the artist wishes to convey; it has neither objective referent in the empirical world nor arbitrary assigned meaning as does the conventional symbol. The qualitative symbol is a non-objective form whose physionomic properties alone evoke experience related to those properties. The treatment of form, line, color, shape, and other visual elements can evoke in the viewer qualities of life that are affect-laden in character. Alternative descriptions of line as fluid or mechanical, of colors as raw or serene, and of shapes as taut or organic indicate the recognition of two meanings: (a) the way in which discursive metaphors are used to capture the expressive character of visual form and (b) the evidence of our recognition of the expressive character of such forms to begin with. These forms are evidence of the artist's recognition of the expressive content of visual qualities. He uses his understanding of the

expressive power of visual form to evoke, convey, and elicit experience. What is termed non-objective art is a prime example of the exclusive use of qualitative symbols in the visual work of art. These forms are, as Langer (4) would say, the forms of feeling and their creation evidence of the nondiscursive knowledge artists possess and by virtue of which they are able to create works of art.

Each of the symbols identified and described--the conventional symbol, the representational symbol, the connotative symbol, and qualitative symbol--represents the units the artist uses to encode the message he is trying to convey; each type of symbol is an element through which the artist's message is realized. Any expressiveness the work possesses is embodied in the symbolic forms the artist employs. The statement "the work of art expresses something" means that the symbols of art used are capable of conveying, eliciting, and evoking an experience that the viewer finds meaningful. But what is required to secure meaning from visual forms? What competencies and experience does the viewer require? It is patently clear that not all people are able to encounter works of art on the plane of meaning. Indeed, the most common complaint of the artistically illiterate is not that the message of art is insignificant but that it is meaningless.

How does one acquire the art of retrieving meaning from visual form? It is to this question that the distinctions made about types of symbols used in art become more than an exercise in analysis. The type of symbols used in art require different types of understanding if they are to be appropriately experienced.

To decode works of art in which large numbers of representational, connotative, and conventional symbols are used requires that the viewer know something of the referents of those symbols. Take for example the painting by Jack Levine entitled "The Senate." The painting depicts a number of men

sitting around a table. The men are well dressed. They huddle around the table. On the table are papers, a pumpkin, and two birds. One of the men wears a pointed black hat like that worn by a witch. To deal with this painting meaningfully, to be able to decode the symbols used in the painting requires an understanding of the symbolic significance of the pumpkin, of the witch's hat, and of the birds on the table. If one is not familiar with the term "stool pigeon," if one has no knowledge of the import of Halloween and of witch hunts, one is likely to miss the message encoded in the work. While the formal structure of the work can, of course, be a subject for artistic analysis, such treatment would short-change the viewer and would render the work ineffective.

To have appropriate experience with visual works displaying connotative, representational, and conventional symbols requires that one understand the relationship between the referent and the symbol, and between the symbol and the work as a whole. In Levine's case, the referents for the symbols used emanate from the McCarthy era. Those ignorant of that era in our history or of the Spanish Inquisition or of similar events will find it difficult, if not impossible, to uncover the meanings built into the work in the first place. It is here that cultural history makes such an important contribution to the aesthetic experience. By providing the viewer with a frame of reference for viewing a work, the artist conveys the richness of the meanings embedded in the symbols. Experience with the work moves from exclusive attention to the primary surface toward attention to the secondary surface of the work as well.

The problems involved in dealing with forms in which only qualitative symbols are used are somewhat different. Since non-objective works display no symbols having referents outside of the work, knowledge of such referents are not relevant to the experience of such works. Non-objective works of art are formal arrays that are to be entertained

for expressive qualities* inherent in the forms, per se. One does not and need not look for referents or analogues in the world aside from the work. Since non-objective works by definition consist wholly of qualitative symbols and are not dependent on knowledge of empirical forms or conventionalized meanings outside the work, they are *in this regard* less culture-bound than works containing conventional, representational, or connotative symbols. To successfully encounter works by Pollock, Kline, Mondrian, Kandinsky, and others working exclusively with qualitative symbols requires no knowledge of concrete forms outside the work. The viewer, in large measure, explores the formal relationships the work displays to gain access to expressive content of the form.

When it comes to a work by Reginald March, for example, the situation is different. Unless the viewer has some notion of what tenements are like, who lives in them, and what life in such dwellings must be like, he will have difficulty appreciating the character or import of the work. The viewer, in short, must have some modicum of experience that impinges on the content of the symbols used in the work. Some beachhead of experience needs to be established outside of the work of art for the artist to vivify that experience through his art.

Caution must be taken in the treatment of works constituted wholly by qualitative symbols, that is, in the viewer's conception of the nature of art itself. While non-objective works do not demand knowledge of empirical forms outside the work, they do require a willingness on the viewer's part to accept such works as candidates for artistic attention. If such works fall outside the pale, if they do not fall within

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* The notion of expressive qualities inherent in the forms per se is derived from the concept of physionomic perception. This concept holds that visual forms have expressive character which are inherent in their organization. Our description of forms having the character of swiftness, sleekness, stodginess and stability is a metaphorical indicator of our awareness of the expressive quality of form.

the viewer's cognitive conception of the nature of art, the likelihood of affective experience with them is minimized. Thus the problem of decoding works using qualitative symbols in part rests exclusively on the viewer's willingness to admit the works into the arena of art.*

The process of encoding visual symbols in the visual arts has certain parallels to the encoding processes used in discursive fields. Encoding requires not only that the artists use or create a symbol or symbols designed to represent, convey or evoke the feeling, image, or idea he wishes to express; it also requires that the symbols be related, that they be ordered appropriately to serve the ends sought. The problem of constructing an appropriate relationship among symbols is one of establishing a syntax for them. This visual logic or qualitative syntax consists of the "rules" through which visual symbols are ordered and is typically referred to as the style or pervasive quality of the work of art.

In discursive communication, syntax and symbol are highly conventionalized and are readily available. As children acculturate, they learn the conventional symbols which serve, at first, to relate the noises called words to empirical referents; in addition, they learn the rules through which the noises are to be related. Deviation from these rules marks one as an alien; and when one is deviant in the extreme, he is out of communication with others. The syntactical and symbolic systems, as Bernstein and others have indicated (1, 3), define communication patterns within sub-cultures and effect the types of cognition that can be exercised within those cultures.

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*The problem of set is crucial concerning the nature of experience people are willing to have with art forms. The set that is held by an individual determines the parameter of expectation that he brings to the forms of art. Those forms which violate those parameters are not attended to aesthetically but assigned to the class, non-art. One major problem in art education deals with the expectation of form their particular concept of art admits.

In the visual arts, too, certain syntactical systems are developed. These systems are created in the visual arts as symbols and are ordered into new relational forms. The spare treatment of minimal art exemplifies a highly restricted coding system compared to the system used in abstract expressionism. In the former, the nature of the syntax precludes symbolic elaboration and confines the artist's statement to the creation of visually simple symbolic forms. Young artists striving to make it will learn the language of the emerging visual syntax and will work within the parameters it presents. Living in New York is an asset for the aspiring young painter, not only because it provides a vital market for his work but also because he has an opportunity to encounter early the new visual languages that creative artists are producing.

There are, however, certain important differences between the symbolic and syntactical systems used in the visual arts and those used in discursive language. Most apparent is the rate with which each type of expressive modality changes. The visual forms of the 1850's are not those of today. Both the symbolic and the syntactical forms have changed enormously. Indeed, if the creation of new art styles is an instance of such change, the language of the visual arts has gone through about a dozen major transformations since 1850. To render comprehensible these languages, one must understand the symbolic and syntactical forms they present.

If the rate and degree of change in syntax and symbol in written and verbal language were comparable to the rate and degree of change that has occurred in the visual arts over the past fifty-year period, we would have a virtual Tower of Babel. The codified rules of discursive language serve to contain and to constrain radical change in discursive communication. In the arts, however, symbolic and syntactical change is sought since through such change, artists help us escape the stock responses and the humdrum. Indeed, change in symbol and syntax appears to be a necessary condition for

the survival of art.*

The development of new artistic syntaxes and symbols depends not only on the creative imagination of the artist, but also on the nature of the materials he has available. The availability, for example, or plastic and the invention of chemical day-glow color have made it possible to conceive and realize artistic possibilities that previously were in the realm of wishful thinking. The invention of the acetylene torch has made forms of sculpture available that Bernini and Donatello could hardly conceive. In short, the material and tools that culture provides affect profoundly the modes and quality of experience that culture can undergo.

Art, like other forms of human experience, is affected by the technology of the time. The tools that technology provides not only make possible new formal qualities, they not only permit the development of new connotative, representational, and qualitative symbols, but they also further stimulate new content for expression. Since these materials affect the formal qualities one works with and since these qualities serve as the medium for the message, the medium, while not the message, shapes the message by its own peculiar characteristics. Artists capitalize on these peculiar characteristics and exploit them for their own artistic ends. The available materials of the time are not mere recipients of the artist's imaginative conceptions; the materials are suggestive and bring to bear on the artistic mind their peculiar characteristics. They open the realm of possibility and in so doing contribute to the expansion of our awareness.

Thus far the attempt has been to identify the meaning of expression as well as to show how the arts depend on human

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*A brillant essay dealing with the conditions necessary for artistic survival and with the evolution of artistic concepts may be found in "The Nature of Art." Morris Weitz, (Weitz, 1966).

intelligence for their expressive power. Further, four of the symbolic elements with which visual artists work and compose into new syntactical structures have been described. The thrust of these remarks indicates that the encoding process in art is a vehicle for the creation and the communication of meaning and that securing meaning from visual forms requires an understanding of the symbols and syntaxes created by the artist.

But, what about the meaning of these ideas for the problems of education? What do these notions imply for educating humans? What do the new media in visual fields hold for educational planning and for educational research?

First, it should be clear that the new materials which are now available to schools can only become media through the process of symbolic transformation. Students can have a hand in using these materials as media in two ways. In one sense, they can be used critically; that is, the new materials can be used by students as vehicles to be decoded, as recipients of meanings already imbued in the symbolic forms the material displays. This has been and is the dominant role students occupy when dealing with encoded forms in school, the most conspicuous form being the printed word. This student role, however, is maintained in newer materials as well, such as their relationship to film, television, and the computer terminals at which they are stationed. In almost all instances, the role of the student is that of receiver. His task is primarily critical and receptive. It is one of decoding messages being channelled through these vehicles.

In another sense, however, new materials can be used as media by encouraging students to use them as tools for expression, to have them use materials productively in order to create meaning. In this way, the new materials that can be used for expression become part of the resources schools would use for the intellectual and sensible development of

student. Schoolmen would encourage students to express and to seek new meanings through the experimental exploration of such materials. At present we have hardly scratched the surface of this possibility. Schools still tend to be bookish in character and the new materials that are used for instructional purposes tend primarily to be vehicles for verbal explication.

Second, if the assertion that the material when used as medium effects the message is true, we might encourage students to attempt to express new meanings through new materials. In terms of educational practice, this would mean providing studios and experimental media laboratories where a host of new resources could be explored and exploited for new ways of forming expression. The overly verbal and didactic character of schools would be ameliorated by extending the range of expressive vehicles students would have the opportunity to work with. They would attempt to construct new forms--some visual, some audial, some multi-sensory--which would enable them not only to transform verbally personal beliefs and observations (something which the school attends to now almost exclusively) but also to discover new content for expression by following the leads suggested by exploration with such media in media laboratories.

Third, if these conceptions concerning media and expression have validity, they appear to be suggestive to the research community as well. The range of media research would extend well beyond the task of attempting to determine how to convey more efficiently what is now carried in words. It would attempt to determine what the unique consequences of nondiscursive media are for facilitating human understanding and for vivifying human experience. We might not be so concerned with using visual modalities as conveyors of discursive data. We would be less concerned with using verbal response modalities for determining effects of nondiscursive input. We would be looking for outcomes that take form in the new materials and laboratories. In short,

our research questions and the data we would seek would lose much of their parochial character because of the wider conception of human intelligence that we would use to generate those questions.

Fourth, as empirical data became available to support our hypotheses concerning the effects of new materials (and of new symbols and syntaxes of expression), we would have factual bases useful for reformulating educational goals. As long as our concept of intelligence is so highly saturated with verbal aptitudes and as long as our educational means and ends are conceived of and dominated by verbal performance, we will always harbor a crippled if not effeminate concept of human potentiality. The data we seek depend on the paradigm of mind we employ. With a more generous concept of mind, we could begin to secure data that might do much to demonstrate the effects of new symbolic forms. Such a model of mind might require new nondiscursive ways not only of securing data but also of reporting the conclusions of our inquiries. This sounds iconoclastic, but where is it written that efforts to understand must culminate in discursive propositions?

Finally, the symbolic and syntactical systems we inherit and create are not merely arbitrary conventions that point to referents in the world of experience. To hold such a view is to conceive of symbol and syntax as passive vehicles for describing experience. I have suggested that the symbols and syntaxes we acquire through cultural forms shape experience. They affect what we perceive and what we believe. They form the maps through which we find our way about. Artists have long know this--and Madison Avenue employs it on a regular basis. If education has as one of its goals the expansion of human consciousness, it can not achieve such a goal and at the same time restrict its attention to only, or even primarily, what discursive systems can convey. Research into the educational uses of media might make its most important contribution to education by expanding our understanding of the potential of the human mind.

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That a weekly meeting of teachers for using apparatus, and other exercises in relation to their schools, would have a tendency to raise their qualifications and to increase the value of their services.

---*The Constitution of a Lyceum, 1829*

MEDIA RESEARCH PROJECTS: CONSIDERATIONS FROM A PERCEPTUAL POINT OF VIEW

malcolm I. fleming

SOME of the deterrents to the conduct of research dealing with media in the context of perception are definitional. Not only is a medium difficult to define, but so also is perception. For example, a medium such as television can be defined as hardware, i.e., in electronic and mechanical terms or as software, i.e., as a script or a videotape. Generally speaking, researchers' definitions of television have differed in emphasis depending on their discipline: media professionals tending to emphasize the stimulus aspects and behavioral scientists tending to emphasize the behavioral consequences.

The difficulties the researcher encounters in defining media extend as well to the operational definition of media variables. One approach has been to employ media per se as variables, i.e., to compare film with TV, programmed instruction with conventional. It is now apparent that such gross categories yield research data that are meaningless, for the within-category variance turns out to be potentially as

great as the between-category variance. A more fruitful approach is to employ within-media variables, i.e., to compare films with optical effects and without, to compare programs with constructed responses and with multiple choice. Such variables are particularly appropriate where the interest of the researcher, or of the funding institution, is limited to a particular medium. However, this writer's preference is for an essentially media-free definition of experimental variables. For example, such variables as the order in which the learner encounters certain cues or certain concepts in a message, or the length of his encounter with any one cue or concept in a message, are media-free, i.e., they are not limited to a particular medium. It may be more appropriate to call some of them *pan*-media variables in that they occur in essentially all media. Characteristic of this approach is the use of the term "message" to refer to that "thing" which the subject encounters, whatever the medium involved. The experimenter's choice of medium for the display of his messages then becomes a matter of convenience, economy, or availability on the one hand, and on the other, a matter of which medium permits the desired types of displays and degree of control. From such studies, comparisons with and generalizations to studies in other media can be made where comparable variables have been investigated.

The definition of perception also presents serious problems. Bartley, (2) for example, cites a half dozen different definitions from the literature and himself chooses one relying heavily on a time line. Perception is seen as "the overall activity of the organism that *immediately* follows or accompanies energistic impingements on the sense organs" (2:22). As this definition suggests, one of the primary difficulties in defining perception has been that of distinguishing, both conceptually and procedurally, between perception and the subsequent cognitive processes such as learning and concept formation. Other recent writers have conceded the artificiality of such distinctions. Forgus (9), for example, considers perception to be a process of information

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extraction, a process in which perception interacts substantially with the other cognitive processes. Neisser (15) in a book titled *Cognitive Psychology* deals almost entirely with vision and audition, topics which in the past have been primary foci of the study of perception. It thus appears that the study of perception can be constrained to some rather arbitrary and isolated segment of the cognitive process or can be conceived as an integral part of it.

For the purposes of this paper, messages will be seen as objects of the perceptual process, objects which both facilitate the process of information extraction and place limits upon the amount and kind of information extracted. Within this context, interest lies in such problems as the media correlates of perception and the perceptual correlates of learning.

The media researcher (or, as we shall call them here, message researcher) might assess his interest in perceptual data with reference to several considerations. First, it is the contention of this paper that the antecedent character of perception, relative to such cognitive processes as learning, concept formation and problem solving, gives perception the status of a prior condition for such other processes. For example, in a concept formation or problem-solving situation, the perceptual conditions may be highly

determinative. In many studies of concept formation the subject's primary task can better be described as the *perceptual discrimination* of the relevant attributes than as the *learning* of a concept or the *solving* of a problem, for the latter typically follow rapidly once the discrimination is accomplished.

A second reason for a message researcher's attention to perceptual data is that the very immediacy of perceptual responses in relation to stimulus conditions more directly and positively relates stimulus with response. This has the effect of reducing the import of arguments favoring attention to one over the other--arguments such as Gropper's (11) for *response*-oriented research or arguments such as those of many audio-visual professionals for *stimulus*-oriented research.

Thirdly, perceptual responses typically permit a more detailed and interactive account of the transaction between the learner and the medium than do the response data typically collected within a learning paradigm. For example, eye-movement data can suggest the order in which the learner deals with stimulus elements and the amount of time he spends attending to each element in a display, while recall data yields only the eventual consequence of such antecedent perceptual behavior. However, the distinctions here labelled as between perception and learning might more profitably be viewed as temporal distinctions within a cognitive process.

In sum, the collection of perceptual data in message studies, while not yielding sufficient information in most cases, can provide the basis for a more complete and more analytical account of the learner's behavior with reference to more of the details and subtleties of the stimulus.

In the search for interesting message variables, a kind of perceptual analysis of messages may be appropriate. The intent is to seek basic units or elements common to messages in several, if not all, media. For the verbal components of

messages, i.e., those employing digital signs, there are a number of reliable taxonomies which provide sets of researchable variables. Examples are letters, syllables, words, phrases, sentences. Words, for example, can be categorized by length, part of speech, frequency of use, sense or nonsense, degree of appro imation to English word structure or order. However, for the pictorial components of messages, i.e., those employing iconic signs, there are very few reliable taxonomies for use as sets of experimental variables.

As a step toward remedying this deterrent to research, this writer directed a study (7) in which a sample of illustrations from 40 textbooks in four subject areas was analyzed. This analysis provided the basis for the development of 13 scales, such as area, framing, position, chroma, encoding medium, encoding style, information level. Scale 5, for example, categorized illustrations with references to their constituent elements, i.e., whether they contained pictorial elements in combination with verbal elements, pictorial elements in combination with design elements, or a combination of all three. Scale 10 categorized the information level of illustrations, i.e., the degree to which the following factors were present: the environment or the ground for the subject of the picture, the shading of the subject, the dimensional cues other than shading, and the internal detail of the subject. Using this scale a researcher would rate an ordinary photograph as level 1 and, at the other extreme, a silhouette or outline drawing as level 5.

These categories of pictures were shown to occur differentially across types of school subject matter and across types of instructional objectives assigned by teachers to the illustrations. However, systematic investigation of the relationship between these message characteristics and the perceptual and learning responses of subjects is yet to be undertaken. At minimum, these scales should alert the

researcher to the variety of dimensions that he can control or vary as he deals with pictorial stimuli. There is no longer any excuse for employing outline drawings in a study and generalizing from them to pictorial materials having markedly different characteristics.

Other studies dealing more abstractly with nonverbal elements have employed geometric figure, sometimes randomly generated, which employed elements such as line segments, asterisks, etc. In recent unpublished studies of memory in relation to visual imagery, Bower has employed what can be called a slash in stroke alphabet. This is comprised of a variety of line segments, the horizontal ones running either up or down, and several diagonal ones. From such alphabets, a very wide range of sizes and shapes of geometric and iconic figures can be generated, either randomly or systematically. Such figures can be categorized with reference to the number and type of constituent elements in a way or to a degree that has not been attained with other approaches.

Somewhat more realistically, a series of studies by Harrison (13) employed schematic representations of faces which were constructed from a limited alphabet of features, such as mouths which curved up or down or were straight.

Recent physiological evidence regarding visual perception (10:118-124) supports the notion of a kind of alphabet of stimulus features which the visual system can readily detect. The visual system does *not* appear to be a simple point-for-point system in which a point of light from the environment stimulates a point in the retina which in turn stimulates a point in the visual cortex. Rather, a feature of the environment such as a horizontal edge or contour stimulates a whole *pattern* of retinal cells. But the effect in the visual cortex is such that one brain cell can respond differentially to the whole retinal pattern. For example, one cell will respond maximally to a vertical edge, while another will respond maximally to a diagonal line, and still another will

respond maximally to horizontal movement. Thus, there appears to be a capability for selectively detecting certain stimulus features as *wholes*.

This capability is of particular interest because some of the experimental visual alphabets discussed earlier are to a degree consistent with those features found to be of physiological import. Further, some of these same elemental features are of significance to the practitioner. The line, for example, has long been considered by artists to have important aesthetic and expressive qualities. For the message researcher dealing with iconic signs, further studies are called for which investigate elemental stimulus features such as lines, angles, curves, contours, edges, as well as their combination into sense and nonsense figures.

In sum, the further analytical study of visual elements or features would seem to be potentially fruitful for both message researcher and practitioner.

Thus far, perception has been treated as a process of *analysis* in which the constituent elements or features of the environment or of messages are apprehended. However, the perceptual process consists not only of analysis but also of synthesis. Perceptual processes are wholistic as well as atomistic. The perceiver attempts to construct unified good figures and coherent events out of the sense data he receives, and he gives them the most likely interpretation that the sense data and his experience will allow. Where sense data are insufficient, the perceiver's own experiences and needs become increasingly important determiners of his perceptions.

But these general findings from perceptual research require further verification and delineation in instructional contexts before they are of use to the designers and users of instructional materials. For example, it is one of the so-called laws of perceptual organization that objects or events

that occur or are encountered in close spatial or temporal proximity will tend to be grouped or functionally related, i.e., similarities or commonalities are perceived when stimuli are proximate.

Work in discrimination learning, however, suggests that proximity of stimuli also facilitates the perception of differences. A relevant question for message researchers is, Where two stimuli are displayed side-by-side in close proximity, under what conditions will similarities be perceived and under what conditions will differences be perceived?

A perceptual development dimension to the question is suggested by a study by Vurpillot (17). Subjects were to make a judgment of "same" or "different" with reference to side-by-side pictures of two houses. The six windows in any one house were all different, having certain curtains or shutters or flowers. However, in half the stimuli, the windows were identical between houses, i.e., windows in the two houses matched exactly in size by location. In the other half of the stimuli, there were differences between some of the windows in matching locations.

Ideally, an adult subject would need to perceive only one difference to report the houses different, but would need to compare all window pairs to report houses the same. In contrast, subjects under six years of age in this study reported either similarity or difference after scanning half or fewer of the windows, and these were frequently not paired comparisons between matched locations in the two houses. For example, in inspecting identical houses, one almost four-year year-old fixated only four of the twelve windows, including no matched pairs, and incorrectly judged the houses to be different. A four and a half-year-old in inspecting identical houses fixated half the windows, including two paired comparisons, and made a premature but correct judgment that the houses were the same. Subjects between six and nine became increasingly adept in search strategy, making more

paired comparisons and varying the overall number of comparisons as needed to establish difference or similarity. For example, a six and a half-year-old in inspecting identical houses fixated every window and made paired comparisons of five of the six pairs. He correctly judged the houses to be the same.

While perceptual research has investigated the behavioral consequences of different arrangements and structurings of stimulus elements (as just noted in the Vurpillot study), it is pertinent here to note that much learning research has also been done with similar types of independent variables. It has long been known, for example, that the beginning and end of a list of words are better remembered than those in between. Where the words are presented one at a time in sequence, this primacy and recency effect would seem to be a temporal phenomenon. From a perceptual point of view one might observe that the only parts of such a stimulus structure that are distinctive enough to facilitate perceptual grouping are the beginning and end points.

Where a rhythm is introduced into such a task, learning can be increased (15:233). An example of such rhythm would be the introduction of a pause after every third word. Although such stimuli contain more information to be learned, namely the rhythm pattern, memory is facilitated. Perceptually speaking, such stimuli exhibit a degree of organization or structure which facilitates differentiation and grouping. In a sense, each three-word group becomes a figure which can be differentiated from the others and which fits well into the limits of memory span. The stimulus information can be said to be in a partially coded form that simplifies perceptual processing.

When a spatial dimension or structure is added to such tasks, learning can be further increased, and the effects of primacy and recency tend to disappear. For example, Asch (1) displayed a list of syllables in several different

spatial patterns. He found significantly fewer errors when the syllables were displayed successively in a triangular pattern than when they were displayed successively in one location. There were 149 errors when the syllables were displayed successively in one location, 121 errors when they were displayed successively in a linear pattern, and only 85 errors when they were displayed successively in a triangular pattern. Interestingly, there was a marked difference in the type of error which was typical for each stimulus structure. For example, for the triangular pattern, there was a marked reduction in errors among adjacent syllables. The lowest number of such errors in the entire experiment was between those syllables located at the vertices of the triangle and those immediately adjacent.

Thus far, perceptual and learning gains have been noted with reference to stimulus structures, both temporal and spatial, that are essentially meaningless or that are at least not meaningfully related to the material being encountered. Much more marked facilitation can be noted where words are *meaningfully* arranged in certain spatial structures. For example, Bower (3) found that over twice as many words were recalled where the words were *meaningfully* arranged in a hierarchical structure as compared to when they were randomly arranged in such a structure. In only four trials, the group encountering the meaningful structure learned a surprising 108 words, while that group encountering the random structure learned only 46 words.

The replication and extension of such studies with meaningful classroom materials would seem to be a fruitful area for message researchers to exploit. Various media permit various temporal and spatial structurings. Individual textbook illustrations permit the study of spatial structures while audio tapes permit the study of temporal structures. Film and television media permit the simultaneous and interactive study of both spatial and temporal structurings. Perhaps one type of stimulus structuring could experimentally

be placed in competition with another so as to discover their relative strengths.

Message researchers might also find profitable the study of message structures with reference to different subject matters. For example, the left-to-right time line has long been used to give order to historical events, and the circular figure is commonly used in biology to represent life cycles of plants and animals. Are these optimum matches of substantive structure and message structure? Do they facilitate perception and learning? Can other spatial and temporal structures be invented or adapted which will facilitate the perception and learning of other types of concepts?

A study by DeSoto (5) suggests one line of investigation for such questions. He found that certain kinds of concepts or relationships were better learned where the constituent elements were spatially arranged in a certain pattern. Specifically, problems presented in syllogistic form were more accurately solved when the spatial order of the elements was consistent throughout. For example, in the following syllogism the light-to-dark order of the elements is maintained:

A has lighter hair than B.
B has lighter hair than C.
Does A have lighter hair than C?

Whereas, in the following the light-to-dark order is changed:

A has lighter hair than B.
C has darker hair than B.
Does C have lighter hair than A?

Responses to this syllogism were 63 percent correct when the order was consistent but only 39.7 percent correct when the order was changed.

However, even when elements were consistently ordered within a syllogism, some orders appeared to be more readily learned than others. The following syllogism is arranged consistently in a better-to-worse order:

A is better than B.
B is better than C.
Is A better than C?

Similarly the following syllogism is arranged consistently but in a worse-to-better order:

C is worse than B.
B is worse than A.
Is C worse than A?

Responses to the better-to-worse order were 67.5 percent correct while those for the worse-to-better order were only 47 percent correct. Apparently, logical thinking tends to be directional in such cases, "better" being conceived either spatially to the left or worse, or temporally as occurring before worse. DeSoto (5) refers to this phenomenon as spatial paralogic. The above-below relation was also tested and a directional tendency found favoring the above-to-below order. In contrast, no directionality was found for the lighter-darker relationship.

There is also evidence that graduate students reliably assign certain types of substantive relationships to certain forms of structures. In a study by Fleming (8), subjects were to judge the presence or absence of certain relationships between elements in various spatial structures. For example, when one element was placed below another in the conventional hierarchical d agram, their positions was judged by most subjects (at least 13 of 15) to suggest greater-lesser relations, before-after relations, cause-effect relations, and part-whole relations. In contrast, when the two elements were placed on the same level in the hierarchical structure, none of the four relationships was reported.

Many other structures were also tested (8). For example, two adjacent elements on a circular structure were ascribed strong before-after and cause-effect relations when they were connected by arrows, but were ascribed no relationship when arrows were absent. Consistent with DeSoto's findings, a

greater-lesser relation was ascribed much more frequently to elements in a vertical-linear array than to such elements in a horizontal-linear array.

As these studies suggest, the basic phenomena of *perceptual* organization or structure have proven productive as well in studies of learning. Such studies add further weight to the suggestion that researchers in media could productively conduct extensive series of studies of the relationships between various digital and iconic message structures and the perception and learning of various forms of conceptual relationships.

In the past, atomistic and wholistic conceptions have been largely irreconcilable in theories of perception. Recently, Neisser (15:86-104) has described the visual process in such a way as to suggest a partial resolution of the two. Vision is shown to consist of two different but highly interrelated systems: central and peripheral. Central vision is atomistic in that highly selected parts of the environment are presented to the very small central area of the fovea for detailed analysis. The fovea is capable of fine color discriminations and the resolution of fine detail. But only about one four-letter word can be centered on it at one time under normal conditions of reading distance and type size. However, the eye moves, so that new information is presented to the fovea about three times a second. From this rapid series of fixations, an image of a sentence or a picture is sequentially built up or synthesized by a process called analysis-by-synthesis.

However, all this atomistic vision takes place within the wholistic context provided by peripheral vision. While there is a marked loss of color and resolution capability from the fovea to the edges of peripheral vision, there remains the ability to spatially localize and differentiate objects within the whole visual field. Thus, the tiny aspect of the environment which is in central vision at any one moment is

seen in relation to the whole visual space, the gestalt, if you will. This conception of a dual but highly integrated visual system has important implications for the message researcher.

As an example, it is apparent that foveal vision must be used sparingly and efficiently because of the smallness of the fovea. This condition aided in the interpretation of perceptual data in a study by Mackworth (14). An aerial photo of a peninsula was divided into inch squares and presented square by square to subjects for rating as to informativeness. The photo was then presented as a whole to other subjects whose eye movements were recorded. Subsequent analysis of the eye-movement data was by squares. It was found that, in general, the fixations were concentrated on the squares which had been independently rated as most informative. This was as expected. However, there were some exceptions to this pattern, and these seemed to be limited to the squares containing exceptionally regular and dominant contours. The suggested interpretation was that the regular contours, while judged to be high in informativeness, were, because of their goodness or predictability or redundancy, adequately apprehensible with peripheral vision. Contrariwise, the high information areas which contained more irregular and unpredictable contours and patterns required extensive foveal attention, hence the greater number of fixations. A very interesting line of inquiry for the message researcher might be the application of such methods to the study of a student's perceptions in relation to his learning. For example, one might gather eye-movement data for students who were studying a textbook illustration and answering questions about it. The efficiency of the students' perceptual behavior could be judged relative to teacher estimates of the informativeness or substantive relevance of each portion of the illustration. Also, alternative versions of an illustration could be compared for their effect on eye-movement patterns and on subsequent learning scores.

Another implication of the dual-visual system for the message researcher has to do with one of the communicator's prime problems, that of getting and holding the attention of his audience. It is typically in the peripheral area of vision that an object of potential interest is localized prior to its being given foveal attention. Thus, to attract attention by visual means is largely to appeal to peripheral vision, which, though reduced in acuity and in color sensitivity, is particularly sensitive to movement and to changes in brightness. The survival value to the race of such cues to attention is apparent, whether approaching danger is in the form of a predator or a speeding car. Message researchers might examine the relative power of various stimulus changes in gaining audience attention. Movement of elements in a visual field could be in competition with changes in brightness or changes in color, the latter being interpreted at the edges of peripheral vision as changes in brightness.

Attracting attention is only the initial problem of the communicator, he must then hold and direct it. A series of studies of children and adults by Faw and Nunnally (6) suggests that when two visual stimuli are presented side-by side, the one which is more novel or more complex supports or holds the attention longer. Much further research is needed to examine more fully the implications of such findings for particular instructional contexts and particular learners. For example, given the generality that novelty attracts attention, just *what* is the state of stimulus novelty relative to? Is novelty relative to what the subject expected or to his perceptual set; or is novelty relative to the subject's past experienced; or is novelty relative to the product of his accumulated experience? Another whole series of studies might deal with the problem of stimuls induced set. What kinds of stimulus features and changes (including both verbal and pictorial factors) induce a perceptual set? What stimulus features and changes serve to *extinguish* a perceptual set?

Lastly, I will touch briefly on an exciting area of investigation: the mental image. An early area of logical investigation, but long since banned from the halls of behaviorism, the mental image is once again being reinstated to respectability and, further, appears to this writer to be of considerable theoretical import for message researchers.

A quote from Harré, a philosopher, suggests one line of investigation.

> Postlinguistic philosophy is characterized by the insight that *language is not the only vehicle of thought*. There may be concepts which are not connected, at least in the first instance, with the uses of words. The additional vehicle is the image which linguistic philosophy expelled from paradise. The restoration of the image has come about through the realization that the study of images need not be entirely subjective or without strict canons. Image thinking does have an objective counterpart. Just as propositions have their objective counterpart in sentences, which can be serious objects of study, carrying propositions independent of individual thinkers, so models and pictures can perform the same task of objectivization for image thinking. Thus, a new analytical discipline has appeared in the last year or two--the formal analysis of models. (12:13-14)*

Another line of investigation of the mental image is being pursued by men interested in memory. Several ancient systems for memorizing quantities of data rely on the mental image. Some are being studied currently. Related is the work of Paivio (16) dealing with the paired-associate learning of nouns. He found that instructions to employ mental imagery produced significant increments in learning as compared to the standard instructions to simply associate the two words in each pair.

An extension of such work by Bower (4) adds fascinating ramifications. Subjects were shown pairs of words and instructed to imagine the object pairs in some interactive

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scene. However, instead of instructions to memorize the word pairs, subjects were told simply to rate the vividness of their image on a five-point scale. They then, unexpectedly, were tested for recall in the paired-associate manner. Their incidental recall was not different from subjects who had been given the same imagery instructions but with explicit directions to memorize. And they recalled twice as many words as did control subjects who had been given standard paired-associate instructions. Further, their recall varied directly with their rating of the vividness of their image: just over 50 percent recall for images rated lowest in vividness, and just under 90 percent for images rated highest in vividness.

A few of the many implications of perceptual research have been reviewed briefly. In particular, attention has been directed toward some of the medium or message conditions for perception that might be investigated further. This led finally to a consideration of some of the perceptual conditions for learning that might also be investigated further by the message researcher.

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RELATIONS OF MEDIA TO OBSERVATIONAL LEARNING

frederick j. mcdonald

THE WORK to be reported on here has a history of about ten years. The earliest research was conducted by Bandura, Walters, their students, and other investigators interested in "Observational Learning," a social learning theory.

The history of the ideas underlying this theory is worth examining because the early research had very little to do with media, though the research is highly relevant to the use of media. When I began my work on the training of teachers, media, to me, were simply devices to use (the only medium we used was a videotape recorder which served both for presentation of models and as a feedback system). Subsequently, it became apparent that the problems in which I was interested were problems in how one processes information, the generic problem of all stimulus events, and, therefore, of how media influence learning.

The early history of these ideas began with studies in

child psychology. In his first such research, Bandura pursued an interest of how children learn aggressive behavior. His study of aggressive adolescents dealt with the differences between boys who had a history of acting out aggressive behavior in contrast to those who did not. Bandura was impressed with the correspondence between the value systems of the parents and the value systems of the boys; the boys in trouble because of their aggressive acting-out were in many ways replicas of their fathers. Extensive interviews with the boys revealed how thoroughly they had assimilated their parents' attitudes, even to making almost identical verbal statements about values.

Bandura next conducted an experimental study with nursery school children. He presented them with a model of aggressive behavior and studied the extent to which they imitated the model. He found a significant amount of imitation, even to repeating words and movements of the model. In a later study, the aggressive model was presented on film via television. The children again imitated as they had done after observing a live model. The issue of whether the model was observed live, on television tape, or on film audiotape became an incidental aspect of subsequent studies. In the interest of efficiency and economy, observations of the model's behavior were mediated through audio-visual presentations.

In this same period, another point of view concerning which factors were most important in learning grew in popularity. The time was 1962, and B. F. Skinner attracted attention by applying his concepts of operant conditioning to programmed learning. Skinnerian ideas caught on so well that a new orthodoxy on instruction soon developed, with programmed learning specialists and buffs preaching the doctrines of successive approximations and immediate reinforcement.

Bandura's explanations of learning by imitating were an

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alternate and competing way of interpreting acquisition behavior. In his paper before the University of Nebraska's 1964 *Symposium on Motivation*, Bandura uses the standard psychologist's ploy of taking his opponents' position and reducing it *ad absurdum*. He describes, for example, what steps would be required in learning to drive an automobile in terms of successive approximations, if one applied Skinnerian principles literally. Suppose the would-be driver climbs into the trunk. Since he is not reinforced, he will eventually climb out. He works his way forward, in and out of the back seat, until eventually he is in the front seat. This new location offers numerous behavioral alternatives, and it takes little imagination to visualize the innumerable false starts that can be made. The point is obvious: without demonstrations of the desired behaviors, learning can be extraordinarily slow.

The issue as posed from 1962 through 1965 pursued the idea that one can learn more quickly by observing another person's behavior than by being reinforced for enacting behaviors in a sequence of successive approximations. Studies from 1962 through 1964 included conditions in which reinforcement procedures were contrasted with modeling procedures, but it quickly became apparent from 1965 on that the main problem was to explain why learning occurred by observation. Almost all the latter work of Bandura was designed to extend his theoretical framework for explaining why people learn so easily by observing other people's behavior.

From the above theories, I generalized the concepts and methods of observational learning to study a very complex form of behavior, that of acquiring teaching skills. My experiments began with the acquisition of some simple behavior patterns. But as the teaching behaviors to be learned became more complex, opposing imitative learning conditions to reinforcement conditions became an unproductive procedure.

We reached a point in the intellectual history of these ideas when it was clear that there were two ways to learn: by imitation and by being reinforced for making the desired responses. The problem then was to find when modeling was more effective than reinforcement or when combinations of modeling and reinforcement conditions were more effective than either process alone. In a recent study by Bandura, one of the most effective conditions mentioned was one that I had also found effective in teacher training studies: the combination of modeling and feedback (reinforcement) conditions.

These were the major ideas in the development of one form of social learning theory. How do these ideas relate to the use of media? Media presentations of models gave me considerable practical trouble; I was forced to think about where the media as a unique psychological event intervenes in the learning sequence when one uses modeling treatments or a combination of modeling and feedback treatments. Later in this paper, my concepts of some of the important categories of observational learning are presented along with suggestions that certain kinds of learning are facilitated with one kind of media arrangement and others with another kind.

First, let us be clear what we mean by observational learning. Observational learning occurs when we learn by watching another person without being directly reinforced for learning and probably without any overt practice. This explanation of observational learning eliminates two of the traditional components assumed to be necessary for learning,

namely the rehearsal phase and the reinforcement or feedback phase.

Two naturalistic examples illustrate the paradigm of observational learning. There are societies whose major activities are learned by the watching of elders who enact their behaviors. The young Papuans, for example, learn to build canoes by watching older, experienced canoe-builders of the society. When the young men think they are ready to build a canoe, they simply announce that fact. Anthropologists report that they usually build a maneuverable and unsinkable canoe on the first attempt.

Another example is the training of girls from the hill country of Guatemala to work machines in textile factories. The girls sit next to experienced textile-machine workers and watch them. The girl learning does no more than take away the spools at night and put spools in the machine in the morning. After a relatively short period of time, when she thinks she is ready, she begins to operate the machine effectively after minimal practice.

The experimental paradigm of observational learning studies is identical to this cultural paradigm. First, expose a person to a model that is performing the behavior to be learned. Then let the person perform the behavior. The purpose of such experiments is to find out if the person imitates, and under what conditions he imitates. This same paradigm may be adapted to a training program: First, present a person enacting the behavior to be learned; second, provide conditions for reenacting the model's behavior.

When considering the cultural paradigm, the experimental paradigm, or the training paradigm, some of the problems of learning under these conditions become immediately obvious. One of the most obvious problems is controlling the attention of the observer. A second problem is deciding the best way to portray the model's behavior. A third one is the

complexity of the stimulus, the question whether the stimulus is too complex for the learner to "process" simply by observing the model. A fourth problem might be the need for rehearsal or practice because of the nature of the response systems. Complex performances require integrations of psychomotor responses: for these kinds of behavior, some rehearsal may be necessary.

When the concepts of observational learning were first discussed, they were ridiculed on the grounds that something must be missing, people could not learn that easily. Moreover, everybody knew that imitative behavior was childlike behavior. It was silly to think that adults learned in this way. Another criticism was that behavior change did not really occur; the learner imitated behavior but did not acquire it. Since the days when these criticisms were made, they have been undermined by hard data acquired by extensive research.

Three studies represent the research literature in a minor way. First were the studies on the acquisition of aggressive behaviors. In these studies, the child observer watched an aggressive model. The aggressive behavior was fairly simple; for example, in one study, the model was in a room in which there was a Bobo doll (a life-size plastic blow-up). The model punched the Bobo doll, hit it with a mallet, muttered aggressive remarks at it, and engaged in similar and obvious overt acts of aggression. In another study, two children acting as models were playing with each other. One child abused the other, and concluded the scene with the very aggressive act of walking off with all of the toys with which the children were playing.

In these early studies, children observed overt acts of aggression. They were then placed in a room or situation identical to that portrayed. For example, they went into the same experimental room in which the model's aggressive acts were filmed, and were observed there. The experimenters

counted how many times the children hit the Bobo doll with a mallet, how many times they uttered the same words the model had used, and all other instances they copied the behavior portrayed by the model.

Another type of study is the one that Bandura and I did in which the children were exposed to a model who made a certain kind of moral judgment. Piaget's theory of moral judgment postulates that children make two kinds of moral judgments, but in successive stages in their development. He developed his theory from data gathered when presenting children with two kinds of stories, and asking them to make a judgment as to who did "the worst thing." If the children judged one way, they were called *objective* judgers; if they judged another way, they were called *subjective* judgers.

We developed stories of the kind Piaget had used, most of them involving minor legalistic or moralistic infractions, such as raiding the cookie jar. In one of the stories, the first child was always a "good guy" who tried to do the right thing but made a horrendous mistake in the process. For example, a child trying to fill his father's fountain pen drops it, spilling ink all over his father's desk. In the comparison story, the child is obviously acting from less than good motives but he does not do much harm. He knocks something off his father's desk while raiding it for stamps or envelopes but he does no damage. The child is asked, "Who did the worse thing?" If he chooses in terms of the consequences of the action, he is *objective;* if he chooses in terms of the intent of the actor, he is *subjective*. We exposed children who were subjective judges to objective models, and children who were objective judges to subjective models.

Since Piaget was one "foe," we were interested in demonstrating that children could be moved back and forth between stages. Since Skinner was another, we were interested in showing that modeling demonstrations were more effective

than operant conditioning methods. We did reverse the stages. The experiment used three conditions. In one condition, the model was reinforced for making the judgment that he was preplanned to make, and the child was reinforced if he imitated the model. In the second condition, only the model was reinforced. In the third condition, a model was not present, but the child was reinforced if he made the desired judgment, either objective or subjective.

The two model conditions were effective; the reinforcement condition was not. It was impossible to shape the desired behavior in the experimental time. There were, however, no differences between the conditions in which the child was reinforced and the one in which he was not reinforced.

It became apparent that the critical factor in learning by observing was that the model whom the child observed was reinforced for the behavior that the experimenter wished to be acquired by the observer. The reinforcement of the observer during the observation period did not influence his acquisition of the behavior. Note that the mediating process by which the model was portrayed appeared to be irrelevant or of minor importance. The fundamental psychological principle was that if the model was reinforced during the demonstration, the observer learned.

In a series of studies on the influence of modeling and feedback variables in the acquisition of teaching behaviors, we obtained similar results to those obtained in the earlier studies on the imitation of aggressive behavior. Although we obtained results similar to those Bandura obtained, the modeling effects were not very powerful; they were, in fact, rather weak. It was the exploration into why they were so weak that led to an analysis of the influence of media on the observation process.

We were studying how certain behaviors were learned,

such as a teacher reinforcing a child for participating in class discussion. Another teaching behavior that we studied was the question asking form that could be used in a class. By means of television tape we presented model demonstrations to show question asking of a specified kind while trainees observed the teacher. The trainees subsequently practiced the behavior in a simulated teaching (microteaching) situation. We counted how frequently the trainee asked the same type of question as did the model.

A problem developed in these studies that did not immediately become apparent. We were studying categories of behavior, not single acts. In the early Bandura studies, the child imitated single acts; he struck a Bobo doll with a mallet; he did not strike a live human with a mallet. In our studies, the trainees were not literally imitating the behavior. (We did only one study in which trainees retaught the same lesson as that taught by the model. We obtained a high frequency of literal imitative responses.) When the trainees had to generalize to their teaching the behavior they had observed, the effects of modeling were relatively weak.

Our procedure was to expose a trainee to a model teaching a lesson, e.g., a history lesson. In this lesson, he asks a specified class of questions. The observer may be another teacher of history or he might be a teacher of science. He must ask the same class of questions on different content in the same field or on different subject matter. The trainee's problem is to transform the behavior that he has observed into a similar, analogous behavior represented in his own teaching performance.

Assume that we are viewing a model; we perceive a link between stimulus cues and behavior as the model responds to stimuli in his environment. The observer sees both the cues and the behavior. The question is, What is happening while you are sitting there that will subsequently elicit similar

behavior? (In the second step of training, the trainee attempts to enact the behavior he has observed.) Should these intervening events be conceptualized as a storage problem, or is a straightforward behaviorist-type question more relevant: What is eliciting the behavior in the transfer test? In the studies of aggressive behaviors in children, if the child goes into exactly the same experimental room in which the model enacted aggressive behavior, the cues that elicit the aggressive behavior are obvious. They are the same cues that the observer saw in the demonstration: There is the Bobo doll, and there is the mallet. There is a representational carry-over; the learner needs only to recall the words that the model used and his movements. But when the observer teaches a *different* kind of lesson, he is presumably carrying around in his head something that stimulates him to ask a certain class of questions.

At the present time, the problems in observational learning and the theoretical issues revolve around two kinds of questions: (a) What is the character of the mediational responses; (b) How are these links made? The greater the differences between the model context and the practice context, the more obvious it becomes that the connection between the mediational responses and the performance behavior is critical.

At this point, we can relate the points just described to the ideas developed by Salomon (pp. 33-62) and to those discussed by Eisner (pp. 103-118). First, list the class of learning problems that are represented in observational learning. In one type of learning, an individual may already have the behavior available in his repertoire of responses. It may not be a high frequency behavior. The learning problem is to take the low frequency behavior and attach it to a new cue so that it is elicited more frequently. An example can be drawn from the moral judgment study in which some of the children made both subjective and

objective responses, but made one kind with greater frequency. Initially, the subject would say that the child in the story who broke the most dishes "did the worse thing," (when he was asked the question, "Who did the worse thing?"). After he had been exposed to a model, he would say that the child who did less damage but whose motives were undesirable "did the worse thing." When he made that second response, he was using a response that he already had available at some strength in his repertoire. He was now linking it to a cue to which he had previously linked another kind of response.

In the first teacher training experiment that we did, we trained teachers to reinforce students for participating verbally in class. The trainees were using responses already available in their repertoire. Most people have some form of verbal reinforcers that they use for a variety of situations. They can say, "Good," or "That's fine," or Excellent." The training problem was to link these words to a specific set of actions of students. It was a difficult learning problem for the teachers because they have a tendency to hold off using the reinforcer until the student gives a right answer. We were trying to teach them to use the reinforcer for the act of attempting an answer even if that answer was not correct. The learning problem was again to attach an available response to a new set of cues.

That kind of learning can be mediated quite easily by modeling training techniques. The method is to portray the new cues and demonstrate the behavior to be learned as well as the connection between cue and behavior.

Another type of learning occurs when one learns both new responses and the cues which elicit them. There are two kinds of learning involved in this type--learning the response itself and the links to the cues. The early language learning of children is a relevant example. A child may learn some language behavior simply by echoing it. He hears

somebody say "Good morning," and he repeats the words, although he may not repeat them under the same set of circumstances that he heard them uttered originally. Thus, he may learn the response mode without learning the cues to which it should be attached. Or, he may learn the cue-response link as a unit; for example, the child learns to say, "Hello" to each person who comes into his house. The cue is, "Person entering house for the first time;" the response is, "Hello." Again, both the response and response-cue link can be learned by observing.

Learning mediational responses, the third type of learning, is not a substitution of a new stimulus to elicit response nor the acquisition of a new link. The acquisition of complex types of behavior can frequently be explained only by postulating that mediating responses intervene between stimulus and response. The mediating responses are also learned. The question is, Can mediating responses by learned by observing? The answer to that question is obviously, No. We usually cannot observe such responses unless we have developed a special experimental technique whereby the learner reproduces the kind of mediational responses he is observing into observable responses (e.g., verbal, pictorial, kinetic). All we are able to say at the present time is that apparently learners acquire sets of mediational responses which are linked to stimuli and these responses in turn serve as cues for eliciting observable actions.

This kind of learning may be a case of learning connotative symbols, in the sense in which Eisner uses that concept. The appropriate learning model for acquiring mediational responses may be whatever is involved in learning connotative symbols. In learning connotative symbols, one is learning a complex representational system.

A fourth kind of learning may be involved in observational learning: learning the link between a mediational response and the performance behavior. Insofar as

mediational responses are used, this link has to be made. The question is, how is it made?

A fifth kind of learning is the link between the stimulus and the mediating response. Again, the question is, how is the link acquired?

Of the five kinds of learning that we are reasonably certain are involved when one learns by observing, three kinds are not under the direct control of the experimenter studying observational learning. All we know is that if people are placed where they can observe other people, they eventually begin to behave like the people they watch whether or not they are reinforced for imitating. Why and how does learning occur in this way?

There are at least two explanations. One is that covert rehearsal and vicarious reinforcement occurs. While the observer watches a model, he rehearses responses and vicariously reinforces himself for performing these responses or visualizes himself being reinforced because he sees the model being reinforced. An example is observing a commercial in which the product used produces certain highly desirable effects; one visualizes himself engaged in the behavior portrayed for using the product and receiving the same kinds of reinforcements. Another explanation to apply is contiguity theory. We know that these events occur in contiguity to each other and the continuity principle accounts for the reproduction of the performance behavior.

But what has this to do with media? It is obvious that we have used media primarily as a portrayal or representation device. Media have not been used to stimulate, control, or expand upon the development of the mediational responses. We have also used media in a feedback system. The feedback system gives the learner an opportunity to compare his performance to that of a model. We have thought of arranging media systems so that the learner could observe the models

behaving and also observe his own behavior in a directly linked compare-and-contrast system. A feedback system may also stimulate vicarious reinforcement; that is, in watching oneself perform the desired behaviors, one may find a reinforcing event. Media have been used almost exclusively to describe the cues and the responses to cues. They may also show the links between the cues and responses.

Now let us draw some similarities between what presumably occurs in observational learning and Salomon's concepts. As I see the relations, observational learning in some way reproduces the process of "supplantation." On the other side of Salomon's continuum of explicitness, there is, however, no response-arousal condition except by implication. One can assume that some general-arousal to learn has occurred because the learner is motivated to observe the model, but there is no real arousal condition. The earlier studies of Bandura were, I think, in this form. An aggressive act is portrayed and the link between the stimulus and response is easily observed. I think this partial supplantation is analogous to the connection between the stimulus and the mediating response referred to earlier in this discussion. But the basic paradigm for observational learning is the one at the top of the explicitness continuum. Essentially what one tries to do in observational learning is to reproduce that supplanation effect. Assume that the learner is in some way going through an act of supplantation, making some form of covert rehearsal perhaps; or he may be engaging in a form of vicarious reinforcement. Whether we make that assumption or not depends upon what variables we want to use. The kinds of problems that I would describe in the analysis of media in relation to observational learning are very similar to the kinds of problems that Salomon discussed in analyzing the characteristics of stimulation. The psychological problems are essentially the same.

One of the problems in designing media to facilitate observational learning is to find a way to highlight the

response to be learned. Almost all of the problems that we had in our teacher training experiments were related to complexity of the stimulus used in portraying a model. Even though short videotape segments were used, there were enormous amounts of verbal content presented to the learner. If verbal material was also presented in experiments where we wanted the teacher to learn nonverbal performances, no learning at all took place. Apparently the teachers attended to the verbal cues rather than to the nonverbal cues. Problems associated with a concrete-abstract dimension and a complexity of the stimulus dimensions are all related practically to the highlighting of the response to be learned.

Another problem is highlighting the cues to which the responses are to be linked. In the past year we did a study in which an experimenter was present during modeling sessions. As the model portrayed the desired behavior, the experimenter would cue the learner on the behavior to be observed. All conditions in which this cuing was done during the modeling session were found to be highly effective. Again there are intercepts with the work on the problem of controlling the observer's attention. Anybody who has worked with people watching themselves on videotape, for example, knows that there is a phase when people look at themselves and utter profundities such as, "Is that what the back of my head looks like?" Personalogical variables control the perceptual processes of observing oneself as they control other perceptions.

Another problem which is not a media problem is the problem of maintaining the behavior once it has been acquired. When designing instructional systems, the general principle on which most people are now operating is that during the acquisition phase, observational learning is likely to be more effective and more efficient in producing behavior change than are other methods of producing learning. But to maintain learning once it has been acquired, the learned behavior has to be continuously reinforced. In that

respect, media may or may not be of some help, depending on the kind of learning problem with which one is working. In a teacher training program, for example, one can videotape the teacher and give him feedback on a particular type of performance. This feedback acts as a form of reinforcement and maintains the behavior.

Another problem (discussed by Conway, pp. 155-164) which clearly affects observational learning, is the multi-media, multi-sensory stimulation of learning. In observational learning, the learner encodes many different kinds of symbols. As he encodes these variety of symbols in different channels, one would expect system conflicts to occur. As I suggested earlier, the experiments in which no results were obtained were ones in which the learner had to encode and transform messages in different channels, one primarily visual, the other primarily oral. The teachers seemed predisposed to listen to the oral material.

By way of summary, let me suggest that observational learning is an established psychological fact. People do learn by observing. *The media probelm is to use the media to facilitate observational learning.* The facilitation can take the form of a more effective portrayal of the model's behavior.

The problem which has not been solved is how to use media to stimulate the learning of mediational responses. I can visualize, however, a training procedure in which media are used to stimulate the generation of mediational responses. Work has been done by Maltzman in developing creative responses. His subjects engaged in certain types of verbal activities which seemed to stimulate and generate new types of creative responses. This paradigm could be applied to elicit mediational representations needed to carry a learner from an observing situation to a performance situation. The hypotheses that people hold about the characteristics of a presentation on observational learning are the kinds of

hypotheses that have been discussed here--hypotheses about simplifying the stimuli, reducing its complexity, and so on.

The only tenuous point about reinforcement, of course, is the extent to which vicarious reinforcement acts as a mediator in the learning process. That, in itself, has nothing to do with media. Whether one holds that as a hypothesis to explain what occurs in observational learning depends upon how one evaluates the vicarious reinforcement literature and how much he is willing to invest in inferences about processes that are not directly observable.

There are a number of social-psychological type hypotheses about the influence of the characteristics of the model. That again, has nothing to do directly with the characteristics of media. If the influence of a high prestige model, for example, is compared with that of a low prestige model, it makes no difference whether the model is presented alive or mediated on film. They same effects occur whether the presentation is mediated or not. Also, hypotheses about the relations between characteristics of the observer and what is being observed have little direct bearing on the use of design of media.

The main problem is the effects of the characteristics of the stimulus presented. Therefore, any connection made between the use of media and observational learning has to be made in the domain of how the stimuli are used to make links between cues and responses.

The simplest problem, it seems to me, is finding ways to use media to portray the behavior to be learned. The ordinary problems of complexity of stimulus need to be solved and can be worked out either from traditional hypotheses or from new and more imaginative points of view.

My preference in designing training programs is to combine what we know about feedback systems with what we know

about modeling systems to create new kinds of instructional systems that alternate modeling and feedback phases. The guiding principle I enunciated earlier seems to apply, namely, that the modeling is most effective in the early phases of learning and feedback systems are needed to maintain the learning.

What then might the role of the future teacher be? I see this teacher as a learning coach, as an organizer, manager and creator of learning experiences, as a sensitive diagnostician of the needs of students, a compassionate mentor. I see teachers committed to motivating students to learn how to learn and to develop a zest for learning. I see a shift in emphasis from the lower mental processes of uncritical memorizing to a concern with developing the creative, thoughtful, sensitive learner.

---*Edgar Dale, Editor*
The News Letter
March, 1970

FORMS
OF INFORMATION REPRESENTATION
AND COGNITIVE OPERATIONS

jerome k. conway

THIS PAPER CONSIDERS some difficulties in a research area that may have general relevance to instructional media and tries to point a way to the generation of more significant research issues and questions.

The phase of research considered here has been labelled many things. Using the terminology of the current *Review of Educational Research* (7), it is named multiple versus single channel research.

A critical assessment of what has been repeated examination of the same problem for over 60 years must affirm the inconsequence of our knowledge. The most current review (7) in its attempt at brevity and conciseness provides (unintentionally) an amazing distillation of those conceptual questions whose continued avoidance must be intolerable to anyone trying to make sense of the research. An interesting exercise in frustration is to go through the review

attempting to determine first, if a clear referent exists for each use of the term "channel(s)" and second, if the referent is consistent through the review. In all fairness, this is no fault of the reviewer. The review reflects the state of research, even to the extent of providing a bogus rationale in practical affairs for the research which follows. I intend to comment on these matters, for it is exactly in the nature of the conceptualization of the problem that most "channel" research suffers. Although probably true of any area of research, it persists for a number of reasons when a manifest concern is directed to the external conditions of "efficient" information presentation.

Prescription and/or description?

A rather interesting ploy used by most researchers in the area, and a clue to their prescriptive inclinations, is the "naive audio-visualist" gambit. The researcher describes what he claims to be a widely held assumption among producers of audio-visual material, and then proceeds to demolish the assumption with his research. This ploy is most persuasive and subtle, for it at once associates the research with the "real world"--with an apparent relevance to what audio-visualists do, even while it attacks what it claims to be common practice. The first sentence in the AERA review exemplifies this: "A prevailing assumption of audio-visualists and many research investigators is that learning will be more complete as the number of cues in the learning situation increases." Here is a further variant of the "naive audio-visualist" ploy: "An assumption of communicators using multichannel media seems to be that the more channels used to reach the receiver, the greater the amount of communication" (8). I cite this last expression because it resulted in a higher development of the "naive audio-visualist" gambit. The research which followed *both* demolished and affirmed the assumption.

It is apparent that much of the recent research on multiple versus single channel comparison derives its initiation

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and impetus from something less than a well-documented expression of what is currently being done by producers of audio-visual material. Were it possible to clearly index what audio-visualists say about using more channels to reach the receiver, one would still have to assess what they did. From their actions, it is my opinion that audio-visualists are really visualists; and if their actions are to be believed, then they feel that the greatest communication gain is derived from use of a single channel--the visual.

This kind of analysis is in a way quite irrelevant. The key point is that the research problem appears to derive its impetus from a base of general practice, and the researcher believes that his information of the problem and the data and interpretations he offers are in turn relevant to practical affairs.

Now, it may be that this strategy is in some cases warranted. But memorizing a list of nonsense syllables simultaneously presented visually and auditorially is no way parallel to what happens when a learner is exposed to *any* instructional film presentation. Yet this is the range of extrapolation from multiple-channel study data that is often implied. It may be that the situations are "functionally" comparable, but then this would be an extrapolation from theory, not from data. It remains for theory to explicate how they are comparable and how separate studies are functionally similar. Of course, this happy situation does not exist. The dilemma that has confronted multiple versus

single channel research is that in attempting to be prescriptive the context of research has become descriptively more rigorous, and therefore more remote in surface character from "real world" activities. It is not the research which can in itself speak about the "real world"; it must now be theoretical level statements. Many researchers are still not prepared to confront this situation.

What is being studied?

Consider the situation where a researcher presents a series of items (usually single words) to Ss and asks them to remember each item and then tests them for their retention. The items can be presented as spoken or as printed or as simultaneously spoken and printed. This in its simplicity has been the standard "multiple versus single channel" research paradigm. It would seem that it should be rather straightforward to get an unequivocal answer to a question like: Is a combination of two media or communication channels more efficient for the communication of the same information than a single medium or channel? However, it just will not work. Because of several considerable conceptual problems buried in the question, it is doubtful if the question is even answerable in part.

As already suggested, so apparently simple an issue as defining a "communication channel" immediately assumes overwhelming proportions. An examination of the research literature will show that although the term is used freely, it really has no functional specificity. One finds alternatives like "transmission channel," "sensory channel," "pictorial media," "sensory modality," "information channel," used interchangeably.

The handling of the notion of presenting "the same information" in either multiple or single channels has been equally facile and trivial. The simultaneous presentation of the spoken word "apple" and the printed word "apple" we would all agree involves the "same information." But, we

have to be careful. The two items are not physically the same--one is a spoken word with visual attributes. They are clearly *conceptually* the same; they make reference to a single concept. One can give other examples of parallel "same information" combinations where it is even more explicit that the items themselves are physically quite different but conceptually equivalent. For example, the combination of the printed word "apple" and a line drawing of an apple. This latter combination is most interesting because, unlike the earlier example of the spoken word and printed word, it is limited to visual presentation. Is it meaningful to speak of multimedia combination using a visual presentation only? Is it reasonable to try to understand how individuals assimilate conceptually equivalent combinations by drawing from explanatory constructs that are solely appropriate to the discrimination of physical characteristics of a presentation?

It seems that in this domain we have been and are dealing with the manipulation of information and with rather restricted types of information units and the relationships between units. Within this context of the standard experimental paradigm we are further concerned with a specific set of conditions under which information is processed, stored, and retrieved. I would submit that the real issue has lain dormant underneath the multimedia or multichannel question; that is, the relationship between the way information is externally represented and how it is internally processed.

The best example of this hidden issue is the way in which pictorial forms of information representation have *not* been handled in "multiple channel" research. For all intents and purposes, when even considered for experimentation, these forms have come to be regarded as "bristling stimuli"--stimuli with many more cues for the mind to get stuck on. Performance involving these stimuli was assumed to be encompassed by a theoretical framework that has recourse to cue summation and stimulus generalization as explanatory constructs. The attempt has just not worked. For one thing,

the logical argument that held pictorial forms to be external stimuli never seemed to extend to what the researcher actually did. If he paired a word form and a pictorial form and claimed this to be a multichannel presentation of information, then cue specification or stimulus attributes were irrelevant in determining whether the paired presentation involved same or different information. The presentations were implicitly interpreted by the researcher to be conceptually equivalent or not, and from that point on he evoked stimulus-related constructs to explain performance of his subjects. The recourse to these constructs is somewhat gratuitous if, after all, we can look to what the researcher himself did in relating (processing) presentational units as he organized them, and the consequences this processing might have for memory performance. The incongruous alternative arising from such work is to have a cognitive account of the experimenter's behavior and an S-R account of his subject's behavior when they are involved in essentially the same task.

Finally, there are considerable empirical difficulties in conceiving of pictorial forms of representation as just more complex external stimuli. There are conditions of information presentation and information testing where the forms of representation used are externally quite different, yet memory is as efficient as where the form of information representation used to test memory in a recognition test is identical to that presented earlier. Thus, for example, one can use the word "apple" to test the prior presentation of the concept "apple" given in a line drawing form of representation. One finds memory performance equivalent to that where the subject has seen the word "apple" earlier and is tested with the word "apple." These sorts of findings are unaccountable in a simple stimulus-related framework.

A reasonable account of these types of data has begun to take shape in terms of the way in which external forms of representation, and in this case, pictorial forms, are internally represented and used in memory tasks (4,2). This

position claims that simple pictorial forms of representation can be and are transformed internally through a cognitive operation of linguistic encoding. This transformation although not the only cognitive operation which these forms undergo, is the one most characteristic of them. This idea is not entirely new. The basic notion of linguistic encoding of nonlinguistic events is found in the study of "codability" as a language-related variable affecting performance (1,6) and the Verbal Loop Hypothesis (3).

It is a new approach, however, when brought to the information processing issues that were always implicit in multiple versus single channel research. It seems grossly naive to presume to manipulate information presentations and to provide accounts of information processing without ever attempting to specify what the information might consist of and how it is assimilated by the interpreter of the presentation. This has been particularly true of pictorial forms of representation. These forms are most often approached in the negative terms of what they are not, i.e., nonverbal stimuli. However, in a very significant sense, pictorial forms as assimiliated can be strongly verbal.

We have to rethink our rather gross categories about what it is we are dealing with when we talk about pictures and words. A language-related processing of pictorial forms may be a useful way of looking at the way people handle not only static but also dynamic pictorial representations. How useful this processing is, is still difficult to say. It does raise the more general question of how various forms of information representation are operated on by a human processor. The theoretical constructs man develops and employs will undoubtedly have to recognize the symbol-handling that is specific to that processor and not characteristic of other organisms.

The multiple versus single channel problem has led to considerations of internal "channel capacity" (10). This is

indeed an important aspect of information processing. The issue is important but the answers we have now, I submit, are still very incomplete. Once again, the question of what is processed and how it is processed seems to me a more fundamental and prior question. Rather than focusing on what individuals do under restrictive and extremely atypical conditions of information presentation, a more instructionally relevant strategy would be to examine how they can in fact function to expand information assimilation and retrieval under normal conditions. As we already know, a so-called "limit" on memory capacity is often far exceeded through application of a recoding strategy. The conditions under which memory for pictorial representation occurs, allows for a truly amazing retrieval of the form (9)--yet we know almost nothing of how this occurs.

What an individual can do under relatively moderate levels of information input, particularly when different forms of representation are used in conjunction and are temporally sequenced, seems particularly worth examining. For example, Knowlton's (5) category of the analogical picture presents a most intriguing relationship of forms of representation in interaction. Quite clearly, the verbal context of such a picture transforms the given of the pictorial representation. Thus, for example, a picture of two lumberjacks sawing down a tree can go beyond the information given and illustrate the reciprocal action of muscles in supporting bones. A distinction between "surface" and "deep" interpretation of analogical form suggests itself. The terminology "surface and deep" is, of course, taken from elsewhere and still needs to be explicated here. It does at the least convey a type of discrimination that may have value, and the making of such discriminations is a necessary beginning of movement toward theory.

In sum, I anticipate that we will relegate multiple versus single channel studies to the same woeful category as most comparative media research--an unproductive experience

of only passing, historical interest. As the role of research becomes more clearly associated with the broader goal of a theory of instruction, and as we begin to make discriminations of a higher order than "two of something versus one of another," our efforts may yet become a focal part of the everyday assumptions of audio-visualists.

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. . . We must identify the education gap . . . Only some human ailments can be taken care of by education right now . . . In the long run, education will provide, I think, better employment; education may indeed eradicate the slums; and, certainly, education is the answer in the long run to prejudice and injustice. But if you want to really eliminate unemployment, you create jobs. If you want to eliminate the slums, you clear up the slums, but you don't ask education to do that job . . . When President Johnson said: 'If you look deeply enough into any problem, education is at its heart,' he was partly right and he was partly wrong. One of the unfortunate consequences is that we have become disillusioned about education without really trying it. Because education is a long-term answer to mankind's problems, not a short-term one . . . We must very carefully, at all levels of educational decision making, differentiate between what education can do in the long run and what human engineering can do in the short run.

---*John I. Goodlad, Dean*
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for Project 70's, sponsored
by Schenectady, New York,
Public Schools and NEA

NEW INSTRUCTIONAL FORMATS, THE MEDIA AND MEDIA RESEARCH IN A CRISIS AGE

john p. dececco

WHEN I WAS first asked to participate in a summer conference in instructional media, I was in the midst of my work at the Center for Research and Education in American Liberties on civic participation and education in a crisis age. A few months earlier I had left San Francisco State, just minutes before the students and faculty were hoisting their revolutionary banners. I arrived at Columbia University just as the dust was settling over a campus deeply scarred by the spring crisis of 1968. When Dr. Gavriel Salomon spoke to me about his research on subjective response uncertainty, I thought I knew how uncertainty felt, and I was generating more competing hypotheses about the academe and education than I ever thought possible for a tenured full professor. I urged Dr. Salomon to conduct clinical research on subjective response uncertainty on university personnel. They are the ones who by traditional Establishment criteria had in recent years "made it" on the academic and professional scene only to discover that there are serious, vocalized doubts about the basic fairness of the rules of the Establishment

game and about the value of the game itself.

At the time the invitation to speak was presented, we were engaged in film making at the Center. With gleeful naivete, a lot of rented equipment, and little professional advice, we were trying to make a couple of training films depicting "democratic dilemmas." These are situations in which alternative courses of action in a conflict situation embody poignant value conflicts or choices between conviction and expediency. We used the films to train 40 data collectors who, in turn, were to ask high school students to describe dilemma incidents in which they had been involved.

As a means of extending the training and initiating the data collection, we made a videotape in the first school we entered. The package contained one of the films, an explanation of our research purposes, and directions for filling out the dilemma incident form. On closed-circuit television, in all social studies classes throughout all periods of the day, the videotape played; and we collected data from the more than 2,000 students enrolled in the school. We were rather proud of this electronic research feat, but wrapped in the innocence of university research methodology, we were not fully aware of some important side effects. In gathering data on democratic dilemmas in a school on the brink of student protest, we uncovered so much hushed information on the indisposition of school governance in that school in one day that we were asked not to return the next day when we were scheduled to make observations and conduct interviews.

We were also prey to the fact that Columbia University had lost some of its Establishment legitimacy after the crisis of 1968. Furthermore, several of our data collectors preferred to symbolize their radical politics and personal life styles in ways and with words rarely consonant with school conduct codes. This contributed both to our hasty and awkward departure and to our careful observance of school access and visitation rules on future research sites.

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I describe this incident for three purposes. First, although we were not doing research *on* the media, we were at least doing it *with* the media. Later on, for example, *after* we obtained permission to enter another school, but *before* we actually entered, two-thirds of the students went on strike, and were were able to conduct taped interviews with the adult and student strikers and nonstrikers. It is interesting to note that a cursory reading of the protocols of a sample of students who remained in class (the nonstrikers) reveals that they were not ardent Establishment supporters. They believed, in fact, that the whole school situation was so futile that nothing, including a strike, could help. Second, the incident sharpened my awareness of the very real political context of school governance. One cannot expect to investigate such sensitive school issues as the state of civic satisfaction among high school students within this context and win Establishment blessings.

I now wonder--though the doubt may be incongruous at a research conference--whether it is the theoretical and methodological impurity of field research alone or the risk of martyrdom as well which discourages the practical investigation of the burning educational questions of our time.

Finally, this incident, among several related incidents, illustrated the inescapable moral dilemmas facing the investigator. He quickly realizes that research on the condition of school governance is research on the present moral

condition of the school and our society; research methodology must conform not only to scientific but also to ethical canons. If we really believe, as we did, that the length of one's hair and the style of one's clothing is the individual's private choice, and if we are concerned with how much freedom the school allows students in these matters, can we ask our student data collectors to sacrifice personal taste and symbol for school conformity?

Getting back to subjective response uncertainty and to possible applications of media research, the emphasis of my present work and thought falls increasingly on the first part of the title of this section--new instructional formats. I saw, as well, the futility and, even if it could be accomplished, the danger and the undesirability of attempting to foster a technological or media revolution in an educational system which is highly authoritarian in practice and frequently irrelevant to almost every important personal, social, and moral problem of our time.

My major theme, therefore, is that there must be radical change from the present educational system before we can incorporate into American education the truly magnificient potentialities of the media and media research. If the trouble is with the *system*, toying with the curriculum in some narrow sense will not effectively change the teaching or the relevancy of what is taught. If progressive education is to be reflected by computer-assisted instruction of Shakespeare or the glories of the Puritans and the Civil War, but ignores Marx and black history, then such toying is neither a technological nor a political revolution and will only hasten the demise of American education. How often, if ever, does one find the program or film in our schools which, as Scriven states, makes clear that this "nation was founded on subversion, on bloody revolution, on the wanton destruction of private property, on deliberate disobedience to constitutional authority in a representative democracy"? (7:6) The answer, of course, is that one usually does not find this

revolutionary tradition described in the history textbooks, and, where the new media have followed the textbooks, neither can one find it there.

It is easy to document the thesis that the trouble is with the system, that educational reform must be radical if it is to equip students to live in the Age of Crisis and the Gun. Westin provides these figures on student disruption in the high schools from September to December, 1968 (9):

Type of Protest	Number of Incidents	States Involved
Racial	132	27
Political (including Vietnam)	81	21
Against dress regulations	71	25
Against discipline	60	28
For educational reform	17	14

The historian of American education, Frederick Rudolph in Sunday's *New York Times* review of Harold Tyler's new book, *Students Without Teachers*, had this to say about unrest in the American university:

> The recent upheavals on American campuses are not simply temporary and unpleasant incidents perpetrated by vicious enemies of the social order. The riots may indeed record a social, economic, and political revolution, but fundamentally they are manifestations of the emergence of the university as the central institution in modern democratic liberal society. The military-industrial state cannot exist without it; an informed and imaginative electorate, sensitive to the conditions necessary to sustain human life and spirit, is impossible without it; attacks on the indifference and criminality that have bred our ghettos and rural slums, polluted our air and water and poisoned social life will get nowhere without it. The prospects of American civilization--and all that means for our friends and critics elsewhere--are now entrusted to the American universities. They are the guardians of humane action (5:3).*

Scriven, in describing the magnitude of the contemporary educational and social crisis, writes:

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> What have we done to educate our citizenry for instability, for revolution, for radical intranational and international transfers of effective power, and in particular, for being on the short end of such changes, for unemployment, poverty, retirement, military defeat? Nothing . . . Perhaps the most important cluster of discoveries in educational psychology has shown a staggering lack of transfer of learning between domains and skills which intuitively seemed essentially the same or very close. Even the temporary survival of a society whose citizens are not *directly* educated to instigate and handle radical change is mere luck; the survival of a society whose citizens are educated in a way that *presupposes the absence* of a radical change is likely to be a very short-lived accident of evolution (7:2).

Schieffelin describes how the marriage of the public school and computer technology can further stultify American education. She writes:

> The public school is one of the most lethargic and reactionary institutions in America. The average teacher seems to be from the lower middle class, upwardly mobile, unimaginative, and afraid of change. He likes the security of routine, accepts without question the virtue of compulsory education and its democratic rhetoric, and is by and large subservient to his superiors. Young, creative teachers often have little patience with this stodginess and torpor and even less power to change things . . . Given the present nature of school personnel, there is the danger that any new technology that is applied to the schools will be used to perpetuate an archaic, irrelevant, and educationally invalid system. Throughout history, educational goals have rarely been determined by educational philosophers. Yet certain philosophers and practitioners have a fair understanding of the process of education. If these educators could ally with the technologists, who are not lethargic, then perhaps fundamental educational changes could occur (6:15).*

Finally, I offer a quotation from the Black Student Union newspaper published by students in a suburban New York City school, which paraphrases the Declaration of Independence. It well reminds us of our revolutionary tradition but also focuses on an anachronistic school system:

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> We hold these truths as being self-evident, that all men are created equal, that they are endowed by their creator with certain inalienable rights, that among these are life, liberty, and the pursuit of happiness. To secure these rights within the schools, governments are instituted among the students, deriving their just powers from the consent of the governed, that whenever any form of student government becomes destructive to these ends, it is the right of the students to alter or abolish it and to institute new government; laying its foundations on such principles and organizing its power in such form as to them shall seem most likely to effect their safety and happiness.(2)

To summarize to this point--I believe that the educational establishment requires radical change to meet the crises facing us as a nation and a society. The marriage of media technology with an outmoded school system will be mutally disastrous. Where this marriage has been joined in the past decade, it has frequently resulted in the hardening of the old system and increasing disenchantment with technology and the school on the part of both teacher and student.

Students are deeply disenchanted and rather pathetically immobilized by the irrelevance of their education to many present problems. This is supported by the data we are gathering on civic satisfaction of students in the schools and from newspaper clippings on student protest collected from about 1,800 papers (including the student underground press).

What does the most preliminary inspection of our 7,000 student protocols show? First, we will probably find that most of the students see a lack of due process in school discipline, discrimination, and inequality. They see the limited opportunities for dissent and decision making as personal grievances, not widely shared (as they are) by other students in other schools. They see them not as the result of encounters with the system but with particular teachers and principals in their particular schools. Second, we may well discover, when students find themselves in conflict situations, that they usually see only one course of action--that one actually taken by them and/or their adversaries.

They are usually unaware of the full range of options available for both parties. This, I would guess, results in early behavior rigidity or acquiescence of one or both parties--as we see so frequently in the encounters between university administrators and student protestors.

Third, our content, as opposed to our process, analysis of the protocols will probably reveal that most students do not clearly see that they are ultimately demanding a fundamental change in school governance. There are a myriad of substantive issues that arise in the schools today--smoking, drugs, search and seizure of student property, privacy in the rest rooms, hall and cafeteria conduct, and so on--the sum of which calls for deep change. The reformers and the radicals, the articulate student editors and journalists of the underground press, who raise this basic issue are less than one-half of one percent of student enrollment in the high schools.

Fourth, when we look at conflict *resolution*, we may very well find that acquiescence to decisions made by authority or peers and violence by authority and students are the favored modes of resolution. Negotiation, mediation, petition, and arbitration do not appear to be dominant parts of the conflict resolution repertories of either students or school personnel.

If the formal data analysis supports these tentative conclusions and others like them, we have a rather severe indictment of the educational system, a system which in the past has failed to teach our political leaders and in the present fails to teach students to deal openly and directly and analytically with conflict situations. Further, it fails to teach them to skillfully and constructively use the conflict resolution. The maxim of most school administrators in dealing with conflict is to avoid it at all costs and, if this cannot be done, to settle it as quickly as possible by co-opting the adversary.

School administrators, like the rest of us, after all, have been reared in the American evolutionary historical tradition which teaches that all valuable change must be gradual and within the system. It must occur within our traditional middle-class economic priorities even though these priorities often place property above humane values. So administrators sometimes save the buildings and the university endowment but lose the students! Although our history is as much a history of conflict as a history of economic prosperity, we play down conflict, defeat, war, rebellion, the conflict between the rich and poor, the white and other races. The result is we do not learn how to engage in conflict very well. Our deep propensity to avoid conflict is probably one of our most psychologically and socially damaging attributes in an era of swift change.

To summarize to this point, I have presented some opinion and evidence that the educational establishment requires radical change. The students, I believe, and indeed the school personnel as well, are woefully unprepared by their education to meet and analyze situations in which conflict escalates. They are unprepared to handle with constructive skill, short of violence and acquiescence, the alternative ways of de-escalating and resolving conflict.

What are the various responses that the leaders in the technological revolution in the schools can make to the educational problem as described here? First, take a cautious, evolutionary position, arguing for the gradual translation of the traditional curriculum into media language and electric mechanisms within the present political framework of American education. Second, take a bold elitest position, arguing for a vast overhaul of the school plant and personnel, with the decisions made by enlightened educational technocrats. Third, take an equally bold participative position, arguing for those changes in the schools which will make them radically more responsive to the needs of the students and communities they serve. Such a change could begin with

a broad share in the decision-making power of the schools by all those affected by the decisions and policies made.

I believe the evolutionary position, as indicated earlier in this paper, will result in the emasculation of one's work and the elitest position in its catastrophe. There is probably considerable evidence to support my predictions. The traditional schools show enormous resistance to even innocuous uses of instructional television and programmed instruction. This resistance is further seen in the magnificent creativity displayed by both teachers and students in subverting the best-laid plans of elitest administrators, trying to reform their schools from the top. What I call the participative position may have little evidence to support it as the best of the three alternatives. Simply, however, it strongly implies the virtue of subordinating the means and instrumentation of education to the ends they serve. If the end or goal of education, as Glasser argues in *Schools Without Failure*, is to substitute success in love and in the achievement of self-worth for the failure to love and achieve self-worth, then the participative approach promises best to subordinate the new technology to this humane goal (3:12).

It is considerably easier for me to outline the magnitude of educational change required than to specify in some degree the changes, therefore, I offer the following introduction.

We need new instructional formats to remove particular rigidities that no longer provide an education which students find relevant or necessary. First, there is the traditional division of content along disciplinary lines. The pursuit of the pure discipline enjoys a nobler, more virtuous status than the focus on glaring political and social problems which require the crossing and integration of parts of several disciplines for their analyses and projected solutions. Take almost any current crisis we face--the racial crisis, the generational crisis--and compare the anemic

uni-disciplinary with the heuristic multi-disciplinary approach to their analysis and comprehension.

Or, to put the issue another way, in a problem-centered curriculum dealing with our rapidly changing and pluralistic sexual preferences and needs, is it really necessary to begin with the fruit-fly and recapitulate the sexual behavior of all infra-human organisms? Must this come before we can ask some troublesome questions and make some rather trenchant observations concerning human sexuality, the separation of myth and taboo from what we really desire and do? How much organic chemistry does one need to grasp the nature and effects of the currently popular drugs, their interesting individual mediating and behavioral effects? And if organic chemistry and biochemistry and psychopharmacology are the necessary school prerequisites for a meaningful discussion of drug usage and effects, how many potential student drug users will ever qualify for the consideration of this problem?

But even more tragic in the missed potentialities for the media are the marvelous feats of film and television. These, in particular, reveal to the young their own inner states and motivations which correlate with their preferred modes of sexual behavior and drug usage. Gene Lichtenstein, a member of our Center staff, shows in his film on drug usage among college students how close the skilled film producer and director can get to the open expression of the thoughts and feelings of the young--an accomplishment most noteworthy in the Age of the Wide Generation Gap. A New York friend of mine, John Becker (once a Madison Avenue producer and now professor of media at Queens College) who originated those brief, dramatic cigarette-cancer films we see so frequently now on television, tells me that he knows nothing about media research but a great deal about the media--another poignant reminder that at least some of our research, as well as our instruction, should go "where the action is."

A secondary school rigidity is the physical separation of the school plant as one arena of activity and interest from the community as another essentially unrelated activity sphere. Indeed, Columbia was constructed on the aristocratic European model of the university as a tower and citadel of learning and *belles lettres*, influencing and leading the surrounding community, but remaining solitary and uncontaminated by the community. It provides at best a pleasant reminiscence of a past which probably never existed and for which there is entirely no future prospect. The media, particularly the movies and television, have done more than almost anything else to breach the ivy walls. They have provided a daily panorama of the life in the urban ghetto, in congressional committees, in the public square, in the elegant haunts of the rich and hedonistic and the simplistic, and in the crumpled haunts of the young gyrating to the cacophony of folk rock. Despite this, the school goes on teaching the same curriculum in about the same way that it has taught for the past 100 years. The media surely could end this strange juxtaposition of two realities by doing within the school what they often do so well outside the school--presenting to us the raw and yet human reality of the communities in which we live.

Furthermore, the movement between school and community should be easy and reciprocal. On the one hand, the important social and personal laboratories we must all learn to think and live in are the buildings and streets of our communities; on the other hand, an important locus for development of the requisite cognitive and social skills are the schools.

The town-gown hostility of the medieval university probably helped a young institution gain the sense of mission and integrity it required to survive and develop. Today the academic gown is a symbol of aristocratic snobbery, repugnant to the reform and radical students who would rather tear it than wear it. To them it is a symbol for filching

support from without responsibility to the community which gives it.

Finally, if the students in the colleges and high schools manage to democratize administrative and faculty hierarchies, the media will be of crucial importance in teaching the non-student young and adult populations how to democratize their churches, factories, offices, and homes.

A third dichotomy, which I believe our educational system should well surmount, is the practice of separating education for morality from education for content acquisition, problem analysis, and scientific skill. With our historic and constitutional separation of church and state, we fell into the awful trap of believing that *all* ethical and value considerations were relative and private and, therefore, inappropriate for public school education. This view is as naive, and perhaps as forgivable, as our belief that school integration would reduce color consciousness to color blindness and that color blindness would ultimately solve the racial problem. Human behavior, particularly in its interpersonal, social, and political contexts, is never value free. To think, most certainly to act, is to decide; and man cannot choose among options without committing himself to a set of values.

A friend of mine, a psychoanalyst, tells me that the success syndrome is not uncommon in many of his patients where status and success have opened to them more options than they can handle. Apart from success, status, and gain, they have developed little personal sense of preference and value that would enable them to select some options and relinguish others comfortably. Unable to let go of anything for fear that it will result in some absolute diminution of free choice, they become frenzied, quivering globs of omnipotence. This metaphor may well apply to our society, with its enormous human, physical, and technical resources, yet its apparent inability to solve its many crucial problems.

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The media have always had a traditional alliance with the theatre and concert hall, with the lighting and graphic arts, with the literary tradition of the novel, play, and scenario, and with the journalistic tradition of newspaper, magazine, and television news and documentaries. Because of these diffuse ties, the media rarely make pretense of existing in a moral vacuum. Even when these art forms try only to reveal the reality "out there," they are obviously and necessarily highly selective and interpretive. In fact, their aesthetic skill and appeal lies in how well they simulate and highlight rather than blindly ape reality or, as aptly phrased, how well they "package information."

To remove some of the instructional rigidities I describe, Alan Westin, director of our Center and professor of public law and government at Columbia, has proposed an institute plan for university undergraduate instruction (9). In this plan, faculty members' commitments for the academic year alternate between six-week institute periods and 10-week work periods. These periods are accordingly devoted to research, reading, writing, or active community involvement. The institutes explore the pivotal conflicts of American society such as race, technology, student unrest, and war and peace. They represent intensive and serious faculty commitments to full-day teaching. Their membership consists of faculty, research staff, graduate students, students from the professional schools, and undergraduates. During our spring institute on high school unrest, for example, the participants were four faculty members from Teachers College and Columbia University, including a social psychologist who acted as process observer; several Center research assistants; a media specialist; students from the Columbia law school; undergraduate men from Columbia College and women from Barnard College; and graduate students from psychology, political science, sociology, and education. The students prepared case studies of schools which had experienced exceptional unrest during the past school year.

The institutes represent a considerable investment in the media because of their heavy reliance on films, videotapes, audiotapes, and so on. In the spring institute, producers and directors of the films we saw told us about some of their views, feelings, values, and the technical problems which guided their selections and interpretation of material. We used audiotaping and videotaping for interview training and for the development of skill in approaching students and school personnel in conflict situations. As once wisely suggested, the methodology derives from the students' grappling with the problem. The implacable eye of the television camera focused on our sweating brows as we encounter opposition, challenge, epithets, and flaying fists and arms, ruthlessly reveals how awkward and rigid we become as conflict escalates. In fact, it is my belief that film and television, more than anything else, have given the McLuhan generation its powerful sense of the individualiality and personal life styles it now expresses so brilliantly and conspicuously.

My thoughts about the media and new instructional formats boil down to this: We need to experiment with instructional formats which break through conventional school and university administrative and curricular structures. The media, which have proved their worth and enormous influence outside the ivy walls, require new teaching formats to demonstrate the great impact they can have in making education powerful and relevant.

I have said relatively little about media research, because I am only an occasional consumer of this research. Granting me this almost prenatal innocence, I confess that I have not yet heard arguments which convince me that the research, like the instruction, should not sometimes go where the action is. I am not certain where the action is. I am not certain where all the action is, but at least a significant part of it is in the ad agencies on Madison Avenue, in the TV studios of the national networks and some

local stations, and in the film industry in this country and abroad. There is surely action in New York theatre--particularly off Broadway in the participative living theatre. Here actors and patrons sometimes divest themselves of most of their clothing and superego faster than the ushers collect their tickets. Some media researchers may want to get closer to this action than others. I believe, however, that some relatively direct study of what the most skilled directors, cameramen, and actors do to produce powerful effects will undoubtedly suggest some casual relationships amenable to controlled laboratory investigation. Given the impression multiplicity of factors comprising media instruction, catalogued so brilliantly by William Allen; given the theoretical wisdom and empirical insights of the investigators participating in this conference; and, finally, given the intuitive, almost nonverbal grasp of these factors by the practicing professional, we have the ingredients for the radical expansion of present laboratory theory and methodology necessary for a thorough understanding of the media. I suggest the same interweaving of field and laboratory research which may pay off so well in developing theories of instruction.

Quite evidently, I have dealt very little with fantasy and very much with grim reality. Fantasy dissolves quickly into reality these days as so many of our venerable institutions are caught in the limbo of failure to fulfill old missions and to create new ones. The school and university have reached this crisis point. We have always expected a great deal from our schools. When they fail, it seems American society, in some crucial aspect, also fails. Consider the protesting student, if for a moment we can overlook his political overzealousness, as he must often overlook our bureaucratic inertia. He has a vision for the school and university, perhaps in detail extravagant yet wholly appealing. He sees them as communities where learning and democracy flourish in an atmosphere of open inquiry, frank confrontation of opposing beliefs, of belongingness, and of regard for human dignity and welfare. I know of no

professional persons who could more dramatically help the students transform this fantasy to reality than those who devote their enormous knowledge, talents, and energies to the schools and the media.

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There are vast influences, both from the emotions within us and from groups who are striving to manipulate us for their own purposes, which make it easy for groups and individuals to tend to resort to force and violence to express themselves and to compel attention to their grievances. Yet we as educators must believe that the intellect can and will surmount all other forces and will succeed with increasing frequency as the person, group, or even nation using it matures. To take the position that reason cannot prevail, and that violence and other extremist tactics are necessary, or their use condoned in order to achieve worthy objectives in and for education is to deny the efficacy and the basic value of education itself.

---*Richard Barnes Kennan, former executive secretary, NEA Commission on Professional Rights and Responsibilities*

SUMMARY
AND SOME REFLECTIONS
ON THE CONFERENCE

gavriel salomon and richard e. snow

THE DESIGN of meaningful research on instructional media is a far more complex task than it may seem at first glance. Despite the quantity of research, summaries of research, conferences on research, etc., that has appeared in recent years, no one seems satisfied with the present state of the field. While production of films, tapes, programs, and other "instructional packages" is increasing at a rapid pace, and while new and more sophisticated technology is regularly introduced, theoretical conceptualizations rarely underlie technological developments and no general conceptual framework to provide some integration for this tremendous expansion is in sight. There are some encouraging beginnings, as Allen points out in his paper, yet they appear so far to be isolated, uncoordinated attempts.

Given this general background, it is striking to learn that scholars of such diverse interests and disciplines as represented in this conference share some fundamental views

and assumptions after all, and reach quite similar conclusions. There are of course many important differences among the participants. In spite of this diversity, however, a few common and basic themes emerge from this conference.

In this summary chapter, we risk being too much like the "levelers" of Snow's paper, perhaps reading into the papers underlying ideas and themes that authors may not have mentioned explicitly or have considered. Given this forewarning, we submit that there are three key concepts appearing explicitly or implicitly in most, if not in all, of the papers. These we shall label *interaction*, *conceptualization*, and *organization*.

Interaction. One finds in the papers a basic common thread. It is the notion that the components of any of the phenomena we investigate generally interact in complex ways. Unless possible interactive effects are thoroughly explored, meaningful conclusions and generalizations cannot be reached.

Complex interactions between instructional objectives and media, machines and messages, learners and modes of stimulation, etc., are to be expected and regarded as lawful. Otherwise, there is little that a researcher can do aside from stating that the matter is, indeed, complex. There was a time when universal laws were sought. However, researchers have now become more cognizant of the fact that the impact of A on B depends on many additional factors which we cannot simply push aside by saying "other things being equal."

The idea of interaction can be discussed in various contexts. First there seems to be some general agreement, although still fuzzy, as to the primary object of research, namely, the nature of instructional media. Implicit in all papers is the rejection of media as machine. Rather, the participants seemed to have in mind the notion of media as *the result of interactions between the instruments of*

transmission and the messages they transmit. Allen analyzes this point by offering numerous kinds of stimulus and content variables which he feels cannot be handled in isolation. Mielke devotes his paper to the question of medium-message interaction and raises one of the central questions to be dealt with: What can medium A do that is most appropriate, given its structure, that no other medium can do? His quotation from Carpenter (1:176) provides the idea in a nutshell:

> ...each communication channel [i.e., machine, medium] codifies reality differently and thus influences... the content of the message communicated. A medium is not just an envelope that carries any letter; it is itself a major part of that message.

Eisner seems to have the same idea in mind when he states that

> ...Since these materials [the tools that technology provides] affect the formal qualities one works with, and since these qualities serve as medium for message, the medium, while not the message, shapes the message by its peculiar characteristics.

A similar point of view is expressed by Salomon.

On the other hand, Fleming expresses his preference for "pan media" variables like the organization of stimuli, the order in which the learner encounters certain cues or certain concepts in a message, etc. This may seem to contradict the interactional point of view. The author even states that the experimenter's choice of a medium (in the more daily sense of the word) is a matter of convenience, economy, availability, or a matter of which medium permits the desired types of display and control. This last note, however, clearly implies interaction between media and pan media variables, though perhaps unintentionally.

If instruments of transmission and messages interact, then research on instructional media must focus on the nature of this interaction. That is to say, one is not satisfied with the gross effects observed in an experiment.

The stimulus, i.e., the result of machine and message interaction, appears to be of equal importance.

It is evidently quite possible to study the effects of cuing, prompting, organizing stimuli, etc., but this has little to do with media research. Modeling, as McDonald describes that line of research, was successfully done with the aid of film. But what knowledge has been gained from this research about film in instruction? This is research with media, not on media. To answer a question like the one McDonald raises, namely, how to use media to stimulate the learning of mediational responses, calls for a thorough understanding of the interaction between the machine and the *unique* kinds of messages, message organization, symbol encoding, etc., that it permits.

Another kind of interaction discussed or implied in the various papers is between instructional media, as conceived above, and instructional objectives and outcomes. It is interesting to note that no participant referred to media for distribution or amplification of information. It seems quite clear that media can provide economical teaching, from an administrative point of view, and offer some obvious advantages as an adjunct to traditional teaching, bringing rare or relatively inaccessible information into the classroom. But this is only one aspect of media utilization and research. The more important question concerns the kinds of effects one can anticipate when media are used in the unique ways made possible by their distinctive features.

Both Mielke and Eisner suggest that entirely new objectives need to be formulated and entirely new measuring devices need to be invented. The much-too-common and pedestrian measures of recall, recognition, application, and transfer may not be appropriate to imaginative use of media. This, however, is only part of the story. What may facilitate one kind of learning outcome (even a novel and most imaginative kind of outcome) may not facilitate another.

Under particular external conditions, it may even be of a hindrance. Bringing the war in Vietnam into the living rooms probably evokes strong feelings about war and peace, commitment and sacrifice, that one could not have evoked by other means, perhaps even in those who actively participated in combat. This results from television's characteristic ways of shaping and conveying information. The same scenes will likely fail if shown to facilitate objective judgment of the war, or to establish better understanding of the historical context in which this particular war takes place.

On a much smaller scale, this kind of interaction has been demonstrated by Salomon and Sieber (5). Results showed that arousing uncertainty in a learner, by using random splicing of film scenes, will facilitate one kind of performance, namely, that which requires this sort of uncertainty. But another kind of performance is debilitated, apparently because it requires the arousal of another kind of uncertainty.

A more important type of interaction may be that between learner and mode of presentation. Snow's paper is devoted entirely to this kind of interaction. Mielke, Eisner, Fleming, McDonald, Conway, and DeCecco do not refer to this type of interaction directly. However, the same idea follows from their papers as well. *The moment one is ready to refer to internal psychological processes, whatever the theoretical context, the question of individual differences becomes unavoidable.* Just as it is recognized today that individual differences between soils are crucial for the selection of fertilizers, so the same must be the case with humans. On this basis, the need to search for ATI's (Aptitude-Treatment Interactions) is discussed at length by Snow. Abilities, personality, and attitude variables, entering knowledge and skills, etc., become independent variables in media research.

The process of choosing appropriate aptitude variables for inclusion in a particular kind of research leads directly to a second idea to be emphasized in this summary. Most participants seem agreed on the need for deeper, more rigorous conceptualization.

Conceptualization. Researchers are typically concerned about the population of subjects to which their findings generalize. No researcher will fail to describe his sample in detail and many take pains to secure representative samples of subjects. At the same time, the question of sampling of stimulus situations is overlooked. Conway states this clearly when he questions the representativeness of single-word learning or the acquisition of paired associates.

Research is usually a compromise between accuracy and relevance. But the two need not be mutually exclusive. A procedure, a task, a mode of presentation may lead to accurate and valid conclusions and still be relevant to the world "out there." This process takes place when the tie between the "out there" phenomenon and the experimental treatment is convincingly clear. We need to *show* that what we employ in the laboratory is a fair, although simplified, representation of the class of events (stimuli, tasks, materials) in which we are *really* interested. This is what we can call "ecological validity."

The treatments and stimuli used in an experiment are valid to the extent that they represent a construct or interest. A construct can be operationally defined in many ways, but it is of little theoretical value to learn the results of a study whose experimental conditions are operational definitions of *themselves*. One goes about establishing the tie between the construct and the experimental operation by either explicating the former or conceptualizing the latter.

Conceptualization or, better, theory, should be the goal of research; but it is often absent in typical research on media. A number of participants in the conference showed concern for this problem. Hence, the strong emphasis on conceptualization and theorizing.

But conceptualization is not the same as generalization. Generalization is a function of similarity or representativeness. The learning of specific nouns in a paired associate list, as observed in the laboratory can under certain conditions be generalized to other words in other paired associate lists. The finding that a sample of students from Introductory Psychology I learned French verbs quicker when given a programmed text, is generalizable to some extent. But this remains a rather gross generalization at best.

When we conceptualize we see not only the wider range of phenomena but also their internal relations, their parts and the contexts in which they appear. Generalization is based not just on *structural* similarity: it is rather a generalization of a higher order, based on *functional* similarity.

Stolurow (6) points quite clearly to this difference: "...Instruction is characterized in terms of a set of functions, not in terms of a set of physical components. Every function can be accomplished by a variety of means." Thus, we create concepts which specify functions, not just generalizations about physical attributes. A similar point is made by Lumsdaine (3) and has been echoed many times in the present conference.

Conceptualization implies understanding the functions something involves. Thus, Allen makes reference to "Factors relating to psycho-physical processes"; Eisner speaks of evoked experiences; Salomon asks, "What Does it Do to Johnny?" Snow analyzes the "preferential" and "compensatory"

functions of media variables; Seibert speaks of measuring previously untapped cognitive abilities with media; Fleming discusses perceptual and cognitive correlates of "pan media" variables; McDonald asks how media can be used to accomplish certain learning functions; and Conway refers to the same question by stating that research on media should address itself to "the relationship between the way information is externally represented and how it is internally processed."

Although the theoretical backgrounds guiding each participant are diverse--ranging from S-R theories, through quasi-cognitive S-r-R views, to Gestalt notions--the same main idea comes forth consistently: it is not enough to know that A leads to such and such an increment in learning of B by person C. We need to know what each of them represents psychologically, and how and why it has this kind of effect. We thus return to the study of internal processes and to interactions.

A further implication is that the kind of research advocated in this conference is *conclusion* oriented, rather than *decision* oriented (2). This is neither sheer trial-and-error-like research, nor is it designed to provide immediate guidance to producers or teachers. The research aims at gaining understanding, at increasing knowledge, at explaining phenomena. This aim cannot be served either by blind empiricism or by decision-oriented research.

This is not to say that conclusion-oriented work is sterile, irrelevant, or detached. On the contrary, if the researcher conceptualizes what he does and attempts to understand the functions that his treatments serve, and if he also chooses variables which represent constructs of value, then his conclusion-oriented research may provide far more guidance, in the long run, than decision-oriented studies. Take for example the three ATI studies discussed by Snow. These are all conclusion-oriented studies. No one should consider basing practical decisions on them at this

point. As we understand better the phenomena under consideration, however, there may emerge some rather important practical guidelines.

Conceptualization as discussed here cannot be accomplished in a theoretical vacuum. Moreover, it requires a means not only to tie findings to some theoretical framework, but, more importantly, a way to organize that portion of the world with which the researchers are concerned into some overall scheme or structures. It is to this aspect we turn next.

Organization. Although there is consensus among participants on the general definition of "media" in the instructional context, agreement on identifying the key "media variables" is far from being at hand. It would be naive, however, to expect agreement here, given the diversity of disciplines represented by the participants. For some participants, notably the psychologists, the unit of analysis for both stimulus and response is rather molecular. For others coming from the fields of art and communication, the preferred unit of analysis is more molar and more complex. This difference is important because the two approaches usually lead to different styles of research; one to more rigorous, laboratory-like research (which may, as Mielke hints, miss the essentials of media), the other to "sloppier" but perhaps more inventive and lifelike research.

Are the two approaches as far apart as it might seem? Allen and Snow each offer ideas aimed at reconciling some of the differences, by organizing the various aspects, components, and units of this vast field into hierarchies of media variables. Allen lists several general classes of variables, each of which is then further divided into subclasses. Snow, on the other hand, suggests a matrix of persons and environments, where both are characterized by many dimensions, hierarchically subdivided. As he argues, a "hierarchical order is not proposed as the necessarily true or correct way to

organize stimulus variables, but only as a potentially useful way to think about such dimensions." The two hierarchies differ quite a bit. While Allen puts stimulus presentation forms (e.g., real, pictorial, symbolic, and verbal) at the top of his hierarchy, Snow prefers to start with the general concepts of information, redundancy, complexity, etc. Allen places types of media, in the traditional sense, at the second highest level, while Snow places there the dimensions of rate of information presentation, kind of content, "grammaticalness" of presentation, etc.

The advantages of having such hierarchies as guidelines are quite clear. It is apparent that the minute, "atomic" variables discussed by Fleming, Salomon, Conway, or McDonald are closely related, perhaps subordinate, to the more general variables referred to by Eisner, Mielke, and DeCecco.

Given a hypothetical hierarchy of variables it should be easier to see how the "packages" discussed by Mielke relate to the explicit supplantation of mental processes discussed by Salomon. Similarly, it should not be too difficult to see how the nondiscursive media Eisner suggests for exploration as to their ability to vivify human experience, relate to Fleming's discussion of graphical elements in drawings.

A hierarchical organization of stimulus variables would be of significant help in conceptualizing functional relationships. If B has such and such an effect, and accomplishes this or that function, and if it is a part of a subclass of A, then we can predict what to expect from A as a superordinate category.

Somewhat less general hierarchies are suggested by other authors. Salomon, for instance, discusses by way of illustration the dimension of explicit presentation of information, whose function is, as he argues, to supplant mental processes. At this point two dimensions (playing a subordinate role) are discussed: amount of supplantation and

nature of the supplanted processes. Questions of abstractness and concreteness of information appear even lower on the hierarchy, and types of media are subordinate to the latter.

Regardless of whether some form of higher order organization is eventually found useful, simply the attempt to organize variables appears to be helpful in promoting the conceptualization of what is being studied. This is not true only of stimulus variables. Hypothesized internal processes can be considered individually but eventually one needs to organize them as well into some form of meaningful structures. When researchers ask, as most of the participants seemed to do, what is the relationship between mode of presentation A and information processing activities of B, then both A and B need to be seen as parts of a larger structure. Add to this the dimensions related to learning tasks, and a third kind of hierarchy, perhaps like the "taxonomy of learning processes" (4) is suggested.

Although commonalities emerge, some interesting differences appear as well. Obviously there are theoretical differences between more Gestalt-like views, traditional S-R views and S-r-R notions. Yet these seem relatively superficial. The convergence of views, apparent with respect to research on learning in general, also appears here. Even an approach which may appear atheoretical to some (such as Snow's paper), is really a cognitive-functionalistic view. McDonald, although starting from a traditional behavioristic view coupled with a social learning theory, ends up in a quasi-cognitive (or rather a neo-behavioristic) position. The real differences among participants revolve around the question of *what should be studied.*

Allen provides a general framework for research. His list of variables covers many aspects of research on media. The other participants then attempt more analytic treatment of selected subareas. Mielke concentrates mainly on the

unique message-media interactions, an idea repeated in a different context by Salomon. This opposes Fleming's view which focuses on the basic units or elements common to messages in several, if not all, media. A deep-seated difference is reflected here.

To seek out for study only the unique attributes of media, or only the unique combinations of media and messages, means that more basic variables, which by definition are less unique, are to be ignored. Why? Apparently because no unique instructional outcomes can be accomplished with them. Thus, for some participants, the AV experience as such is not of interest; they would rather focus on those experiences which may serve unique functions in instruction. Fleming and Conway ask questions like: Given mode of presentation A, what are its perceptual, or information-processing correlates? Yet Mielke asks: Given medium A with such and such unique communicational characteristics, what novel kinds of learning outcomes can I expect from using it to its best? Salomon asks questions in a similar vein: Given that medium A is unique for doing this or that, what unique psychological functions are served by it? When are these functions relevant to what kind of learning, and to whom?

Actually the difference between the two approaches reflects a difference between research that aims at general description of "normal" human behavior in "typical" situations and research that seeks prescriptions for new stimulus arrangements and unique behavioral outcomes. To search for perceptual, learning, and information processing correlates of conventional modes of presentation means to study human behavior in the real world toward a kind of norm-referenced or normative psychology. On the other hand, to seek out and capitalize upon unique stimulus constructions and resulting behavior is to build a more criterion-referenced or engineering psychology approach aimed at understanding behavior in newly (and purposefully) contrived stimulus situations.

The two approaches should not be confused with conclusion-oriented research, though the second of the two frequently is directed at specified purposes and needs, rather than general psychological understanding. Also, the two approaches do not seem to call for different methodologies. It is the selection of phenomena and foci which separates one from another, rather than procedure. One might even argue that the one type of research serves as a foundation for the other. A particular study by Mielke for example, might find that a new combination of optical effects achieves some instructional purpose not previously attainable. But when we then ask *why* this effect, it is necessary to revert to the kind of general descriptive research discussed by Fleming and Conway.

Eisner and DeCecco introduce an entirely new focus of attention which is in strong contrast with the other papers. Their main issue is not with how to study media meaningfully but rather with the aims and goals of using media in education. What DeCecco actually told the conference was that from an educational point of view, most research seems to miss the major point. "As leaders in the technological revolution," he asks, "what are the various responses you can make to educational problems?" A major point is that "the marriage of media technology with an archaic school system will be mutually disastrous." Thus, he suggests that we experiment with new instructional formats which break through conventional school and university administrative and curricular structures. This experimentation, in turn, requires some direct study of what the most skilled and creative practitioners are doing already.

This approach is in line with Mielke and Eisner's papers, but it introduces a dilemma: Should we study typical and/or unique behavioral correlates of media used for traditional objectives, or should we rather study the way media can be made to accomplish entirely new, even revolutionary, objectives?

Put this way the approaches appear mutually exclusive. But this need not be the case. We may encourage students to use new materials as media for creative expression, as Eisner suggests, and at the same time use media to convey information. And in conveying information, we may also experiment with the most daring and unconventional techniques, using media to achieve DeCecco's vision of truly powerful and relevant education. None of this implies that rigorous research is unnessary or irrelevant. On the contrary, the more diverse our expected outcomes become and the less uniform our teaching procedures and curricula, the more both conclusion-oriented research and decision-oriented research is needed.

Even decision making, an ability which DeCecco notes is important to acquire, has a social learning or imitative component to it. Now if media are to be used to teach people how to choose between alternatives and take more responsible parts in governing their own lives, and if there *is* an imitative component in the process, then the questions raised by McDonald are quite relevant.

There are other differences of focus which emerge from this conference. Some participants are mainly effect oriented; others are concerned with mediating processes and still others with audiences. As stated earlier, however, these different emphases can be regarded as various dimensions of the same realm and hence complementary.

Reflections

One is reminded of the anecdote about the effects of some films in a general campaign for hygiene in a developing country. One of the issues concerned health hazards associated with flies. One film attempted to dramatize the problem by showing a fly, screen wide, and focusing on each leg, hair, etc. While dramatic beyond doubt in the viewing, the experience didn't seem to affect the housekeeping practices of viewers at all. Later interviews included questions

like, "Didn't you see how harmful a fly can be?" "Yes, we did," came the answer, "and we really think that in places where they have such huge flies, they ought to take precautions." The result of this revelation, of course, was to make the designers think not of what they had done, but rather of what they had failed to do.

We will follow a similar course. It seems that we have, for the most part, concentrated on one fly, enlarging it to tremendous size, but ignoring the more general context in which it operates. We should not overlook the general framework within which instructional media exist. We should also not overlook any approaches to research that offer some promise of utility. Let us therefore examine the wider field and context so that the flies we have been dealing with will appear in the proper proportion.

With the exception of one paper (DeCecco's), all focus on the study of media in instruction for the single learner. Thus, the primary concern is with the mental processes that correlate with various modes of presentation, or on the learning tasks facilitated by them. This, though, is only one aspect of the interrelationships of media and education.

Different modes of information presentation have, no doubt, different kinds of impact on one's immediate mental activity and thus can have different amounts of instructional utility. However, modes of presentation may, in the long run, have much more general effects. Such effects may accumulate and shape to some unknown degree the ways individuals, perhaps whole societies, extract information from different media. The immediate instructional utility of a certain medium could be closely related to the overall impact of media in society.

Research on instructional media thus proceeds on a number of levels of generality. These levels range from fairly specific ones as in the papers presented here to general

levels (e.g., studying the impact over the years of media on the social structure of society). Levels of generality can be distinguished in two ways: *Temporal generality* concerns the time sampling needed to study the phenomenon, ranging from the single-point study (e.g., the way college sophomores react to a certain kind of two-channel input), through the developmental study (e.g., how do individuals develop film literacy,) to the historical study (e.g., the functions that a certain medium fulfilled over the years in altering the character of political processes). *Social generality* refers to the size of human unit sampling needed to study the phenomenon, ranging from specific concern with an "average individual," through the level in which differentiated groups are studied (e.g., the ATI approach discussed by Snow), up to levels where subcultures and even societies are studied.

Research on instructional media, as discussed in the foregoing papers, resides for the most part on the most specific level of generality. Yet, such research cannot shed much light on other more general levels. It can, however, generate hypotheses worthy of examination at more general levels, just as research on general levels can be a source of hypotheses useful on a more specific level. Work should, however, go on at all levels of the generality continuum. At present, several levels appear to be ignored.

In at least two conference papers, reference was made to "relevant aptitudes" which could interact with modes of information presentation. But couldn't it be possible that many of these "relevant" aptitudes are themselves subject to modification by constant exposure to prevailing media? "Media literacy," for example, may be an aptitude relevant to specific instructional outcomes; but it is itself affected by exposure to media. Let us not forget that the immediate psychological impact of a particular presentation

is, to a large extent, a function of many preceding media-produced responses.

Moreover, let us not overlook the fact that the same media and modes of presentation which serve to *differentiate* instruction, serve mass dissemination of information on an *undifferentiated* basis. Given that the mass communication remains a dominant characteristic of our society, it will be useful to study its aptitudinal, attitudinal, emotional, and social effects so that research questions on more specific levels become more meaningful in content.

The conclusion from the preceding discussion is not that research on media should proceed in lock step, linear fashion "downwards" from general to more specific levels, or vice versa. There is, probably, vital information flow in the form of hypotheses and findings from each level of research to every other. A study concerned with the impact of televiewing on social behavior can be supported by information about the development of, say, moral judgment in children, and then fed into research on attention, redundancy, or incidental learning, examined on a much more specific level. Similarly, research concerned with the use of TV broadcasts to facilitate the acquisition of basic lingual and numerical concepts may reply on more general research dealing with televiewing habits of children. The main point is that research on all levels must be promoted and must be interconnected at least by communication. Perhaps a time will come when research at different levels can also be integrated by programmatic coordination.

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